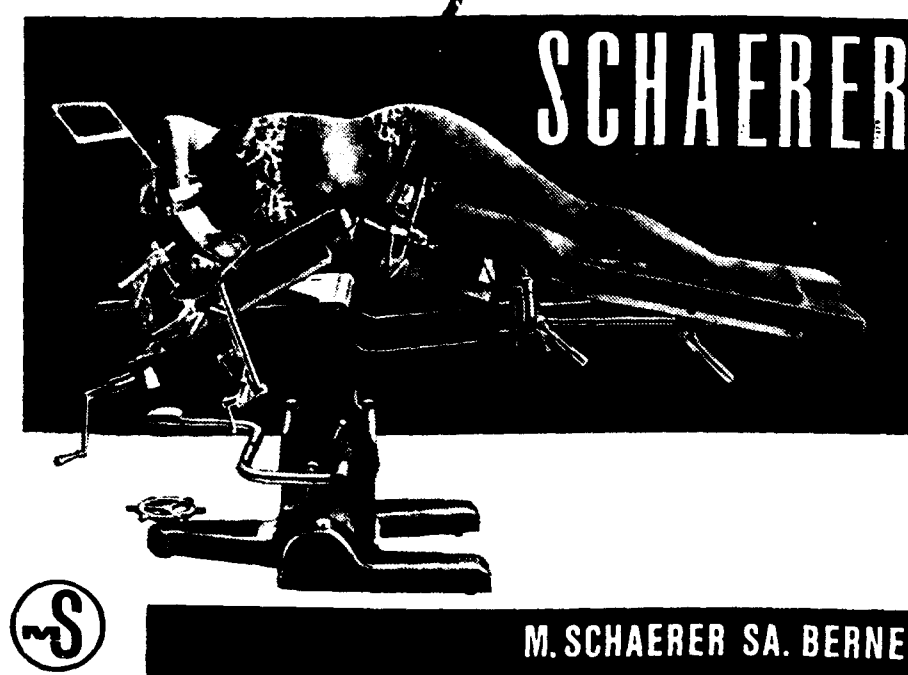


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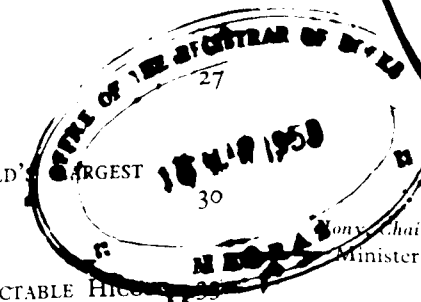
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Volume I No. 3

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CONTENTS

1. WORKING EFFICIENCY 3
2. CANCER OF THE RECTUM 5
3. NEW MEDICAL USES OF RADIO-ACTIVE ISOTOPES 10
4. TOXICOLOGY OF PLASTICS AND RUBBER 14
5. WANDERING TEETH 27
6. ARGONNE HOSPITAL IS WORLD'S LARGEST CANCER RESEARCH CENTRE 30
7. CHLORPROMAZINE AND INTRACTABLE HIC 33
8. ACE SCIENTIST DEAD—SIR A. FLEMING—DISCOVERER OF PENICILLIN 35
9. INDUSTRIAL HEAT-LOAD PROBLEMS IN INDIA 38
10. PRESBYOPIA AND POVERTY 39
11. MEDICINE IN THE SERVICE OF INDUSTRY 42
12. AN APPRAISAL OF THE FUTURE TREND OF MOSQUITO CONTROL MEASURES 45
13. ACUTE ABDOMEN 47
14. MEDICAL NOTES AND NEWS 53
15. SOME ASPECTS OF DISPOSAL OF INDUSTRIAL WASTE WATERS 59



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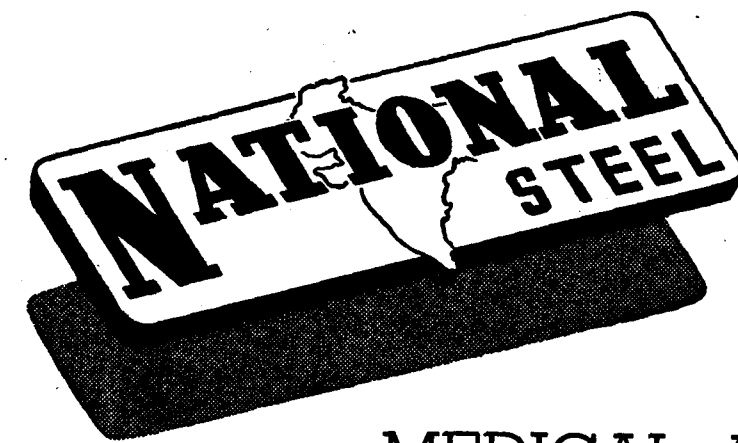
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WORKING EFFICIENCY

THE common cry of the day is that most of our industrial workers are not putting forth their maximum effort in their work. This cry is heard from the public platform, academic circles and the managers' tables. It is said that they are working at quarter to half pressure. Efforts to find the cause for this have resulted in various theories. The most wide-spread being that low wages are the main cause of low turnover, and that temptation of money is the greatest incentive for work. Fear of poverty or to a smaller extent, hope of economic gain is supposed to goad man for more work. The worker is compared, in a lighter vein of course, to a mule which can be driven by the fear of a stick or the temptation of a carrot at the end of it. Even though this appears very judicious and correct on the surface, on deeper consideration or on actual study of statistics it is found to hold no ground. During the war-time, when wages were high, the actual amount of work turned out by an individual was not comparatively high, bigger and larger production was achieved by employing more men. Even today if a strict and scientific method of estimating the output is followed it will be found that "incentive" system will not record a higher efficiency.

It is a recognised fact that the normal man is not an idle man by nature. Idleness is a sign of disease. But there are often many factors which check or inhibit a person from being busy. A proper understanding of such factors may help to raise the working efficiency. No doubt the first factor is the economic contentment, though not luxury of the worker. We need hardly dilate on the point that a half-starving, half-naked father of a dozen uncared kids would make a good worker. Financial stability is the foundation of the workers' hut. Proper and practical instruction on family planning would further strengthen the foundation. Equally important is the security of work. It is gratifying to note that much attention is being paid to this aspect and various laws are being formed.

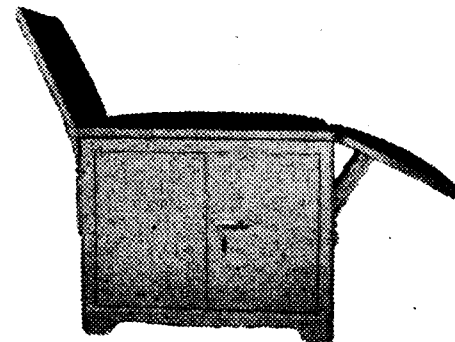
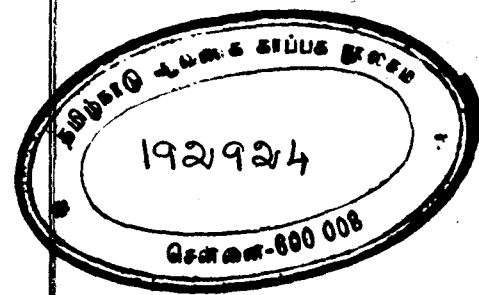
Improvement of the physical conditions of work is certainly essential for a greater output. But that it is not the only essentiality is amply proved by the Hawthorne experiment at the Harvard University. Ideal condition of work did raise the working efficiency. But the gradual withdrawal of the condition did not produce a corresponding fall in efficiency. The maintenance of the efficiency after withdrawal of the "ideal state" was attributed to the "increased interest in their work, resulting from the knowledge of its special importance and improved relationships with the management throughout the experiment period". This again takes us to the psychological and social aspect. One is tempted to infer that it is the psychological and social factors, in modern life which prevent a worker from putting forth his best.



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The absence of natural joy of craftsmanship in the modern type of mass production is held responsible by some authors. The primitive man had a joy for work, what interest can the man who makes the bolts which hold together the propellers, have in the manufacture of aircraft, which is the final product in his line? It is an evil but an inevitable one. We cannot dream of one single man producing an airplane nor limiting industries to single worker only. No doubt a real craftsman feels hurt if his work is taken over by a machine. The strongest stimuli for more and better production is the recognition of the pride and prestige of a skilled worker. Hence many workers get little satisfaction from their work, resulting in lowered efficiency.

Apart from the active life at factory, the domestic condition also go a long way in better production. The health of the industrial population to a great extent is determined by his living quarters, his opportunities for extra-factory activities like social life and sports, not to mention an adequate and satisfactory pay bill. We are tempted to think that the problems facing the working of the Employees State Insurance Scheme would have been much easily and satisfactorily solved, if the Industrial Housing Scheme had been implemented first. Are we putting the cart before the horse?

In this connection a little enlightenment of the worker on his "Job Training" would also be a contributory factor to working efficiency. Job training involves telling a worker what to do, where and how. Modern thinking is that he should also know the why. If he needs to know his job relates to the productive organisation as a whole, he should also know that he has a responsibility to protect himself and his fellow worker. This type of information should be provided in job training.

The worker can use controls provided for his protection in an intelligent way, only if he knows their purpose, their method of functioning, signs of malfunction, and his responsibility in their use and maintenance. The worker can suggest improvements in his working environment only if he knows the reason therefor. Basically he is personally interested in making his workplace a better and safer place to spend eight hours a day. He knows more about certain details of his job than anyone else. If a man is intelligent enough to operate an intricate machine, he is intelligent enough to help devise improvements in his working environments.

In the past there has been considerable reticence about telling the worker of the nature of a hazard, its extent, what is being done to control it, and what he should do to assist in its control. The reason for such reticence apparently has been the fear that this information would be disturbing to the worker; he might be frightened and quit or ask for a transfer, or ask for more pay; his fears might result in a higher accident rate; emphasising health aspects might result in psychosomatic complaints which would be more severe than the health potentials of the job itself.

CANCER OF THE RECTUM

Critical analysis of present factors and recommendations for management

By HARRY E. BACON, M.D., F.A.C.S., F.R.S.M., F.I.C.S.

Professor and Head Department Rectal & Colon Surgery, Phila.

AND

HOWARD D. TRIMPI, M.D., F.A.C.S.

Assistant Professor, Philadelphia, Pennsylvania, U.S.A.

(Exclusive to "Surgical & Medical News")

IT has been stated that one half million persons in the United States are afflicted with cancer each year, which fact is recognised as a challenge to us of the medical profession. According to a statistical survey, thirty three thousand men women and children died of cancer of the colon and rectum in the year 1949. The Director of the American Cancer Society, Charles Cameron, reported in 1953 that of patients with cancer of the rectum, 15% were cured and 85% died. Experience has shown that approximately fifty percent of all patients submitted to surgery are found inoperable from the stand-point of cure. It is further known that in the male sex cancer of the rectum and colon is the most common (Demuth), and in the female sex it is the second most frequent site being next to the breast. (Levin-Haagensen).

Our experience of fourteen years encompassing 1484 cases with cancer of the anus, rectum and colon has availed us of striking facts which are none too pleasing in the cure and control of bowel cancer. The stage of the disease at the time of the first examination is the most important single factor in influencing the cure rate, therefore to make the diagnosis early is the first line of attack. Our only two weapons to combat this killer are:

1-early diagnosis and 2-surgical removal. As to the first one of us (H. E. B) reported in 1938 that the average duration between the onset of the first symptom to the time of the diagnosis was nine months and three weeks as based on a series of 1819 collected cases with rectal cancer. At the time of the present writing, namely 1955, our records show the average to be slightly less than nine months which it must be admitted shows little progress for the intervening sixteen year period in spite of extensive education of the lay and medical public. Dixon, Sugarbaker, McNealy and others have called attention to the frequency of incorrect diagnoses in that some 30% of rectal cancer and approximately 15% of colonic cancer are being treated for conditions other than cancer, such

as hemorrhoids, fissure, colitis, chronic appendicitis, spastic colon, etc. and with apparent ignorance of the true pathology. A more concentrated attack must be made toward the recognition and destruction of adenomatous polyps of the rectum and colon because of their high potential of malignancy.

Intelligent and careful sigmoidoscopy should be a part of each physical examination. No one holds a franchise on the sigmoidoscope and its use should be recognised for its importance. Every physician should continually be mindful that the rectum and colon is the most common site of cancer. Eighty percent of the lesions are present in the distal bowel so that if the physician will introduce his gloved finger 78% of the cancers can be felt and if he will but introduce the sigmoidoscope for the distance of 25 cm. better than 90% of the cancers can be visualised.

There is common agreement that the only treatment for cancer of the rectum and colon is surgery. It has been frequently mentioned that of the patients submitted to surgery, approximately 50% are inoperable from the standpoint of cure. What then of the other 50%? We know that of the best statistics available show only a five years survival rate of 50%. This means that to increase the percentage of cures, a more radical and extensive operative procedure must be instituted. Unfortunately, there is no uniform opinion as to the degree the operative procedure should be extended to effect a cure. Ordinarily one would contend that it is contingent upon the training, experience and fortitude of the surgeon. Two simple facts are apparent—one that surgery is the only available treatment, and two, that the operation so far as possible is instituted to give that patient the very best opportunity for cure. If such is the case then our present operative procedure is inadequate and the scope of the operation must be extended. All will concur with the tenet that every effort to eradicate the disease should be made at the first operation, it being realised

of course that the important single factor which bears influence on the cure rate is the stage of the disease as found when first encountered.

It has been our practice to extend the scope of the resection where instituted for cure, and fortunately this has been achieved without any appreciable increase in mortality or morbidity.

Cecum: For tumors of the cecum and ascending colon a right hemicolectomy is effected to a point just proximal to the middle colic artery and 15 to 20 c. m. of the distal ileum to include their mesentery and node bearing areas about the superior mesenteric vessels. Bowel continuity is established preferably by end to end anastomosis. Where the tumor is located at the hepatic flexure essentially the same procedure obtains except that the middle colic vessels are sacrificed to permit a greater expanse of regional lymph node removal. Particular attention must be directed to the blood supply of the distal segment for the anastomosis, namely the ascending ramus of the left colic artery.

Transverse Colon: It has been our custom to remove the transverse colon for lesions in this location with both the hepatic and splenic flexures and preserve the right and left colic arteries for the anastomosis of the ascending and descending limbs. However, we have on occasions encountered extensive nodal involvement of the superior and inferior mesenteric chains for which reason we feel that a greater expanse of bowel removal with an anastomosis of the ileum to the lower sigmoid as recommended by Rosi is worthy of consideration.

Splenic Flexure: Carcinoma in this area requires extended resection. The ideal is a superior and inferior mesenteric lymphadenectomy and partial colectomy in which the ileum is anastomosed to the sigmoid. The recent suggestion by Madden to include partial pancreatectomy and splenectomy may be viewed with some favour. As early as 1908, Moynihan in discussing cancer of the rectum and left colon, stated "surgery of malignant disease is not the surgery of organs; it is the anatomy of the lymphatics." Even at that date he advocated "excision of all glands as far as the inferior mesenteric artery, its origin from the aorta in the removal of cancer of the rectum and sigmoid. The highest gland in the lymphatic chain must be taken away—nothing else will do." Strange that two score and six years later we renew this procedure and recommend it as routine for all curative resections of the descending and sigmoid colon and rectum.

In 1950, Ault, Castro and Smith reported their experience with high inferior mesenteric ligation and cited five instances in which the vessel was ligated proximal to the left colic artery. Grinnel, whose investigations have always served as an impetus, activated renewed interest by finding that 17% of 41 resected specimens demonstrated nodal metastases.

In 1948 one of us cited an incidence of general nodal involvement of 36.2% in a group of 67 uncleared specimens, while recently Valiente in our Department studied 261 postoperative specimens of rectal cancer of which 116 fulfilled the requirements for clearing. Positive nodes were found in 62.7 per cent. Significantly, 17.8% showed positive nodes located around the origin of the inferior mesenteric artery and proximal to its left colic branch. To the time of this writing a total of 261 ligatures of the inferior mesenteric artery at aortic origin with removal of the lymphatic chains have been performed, of which 116 specimens have been cleared by the modified Spalteholz technique.

Descending Colon: Tumors in this area are routinely extirpated by a left hemicolectomy anastomosing the segment of the transverse colon supplied by the middle colic artery to the low sigmoid supplied by the middle and inferior hemorrhoidal arteries. In this instance there is no need to mobilise the rectal segment. The inferior mesenteric artery is ligated at its aortic origin where the entire node bearing area amply described as "the axilla of the abdomen" can be cleared. The importance of nodal dissection is well shown by Rosi, who in a group of 36 resections for cancer of the descending colon found that 44.4% of the cleared specimens showed metastatic cancer in the nodes that lay in the region of the inferior mesenteric artery and aorta (8% within 1 cm. of aorta, 14% from aorta to 1 cm. beyond the bifurcation of the inferior mesenteric artery, and 22% from aorta to 2 cm. beyond the bifurcation of the inferior mesenteric artery).

Sigmoid Colon: With the exception of the very low sigmoid, cancer of the iliac and pelvic portions is resected and the descending colon, which is mobilized as far as the splenic flexure, is anastomosed to the rectosigmoid or upper rectum. Prior to manipulation of the growth, the inferior mesenteric artery is ligated and divided at its aortic origin; the vein is ligated and divided just distal to the ligament of Treitz. By this means, the node bearing tissues can be stripped clearly from the third portion of the duodenum downward over the vena cava, aorta, bifurcation, common iliacs with the internal and external branches, over the

promontory and into the pelvis. We have not been sufficiently impressed with the value of including the splenic flexure and distal half of the transverse colon for our sigmoidal lesions as has been recommended by State and Waite although we are fully cognizant that the greater the length of bowel removed the greater will be the incidence of additional tumors benign and malignant. It may be recalled that Broad and one of us reported 173 consecutive operative specimens for cancer of the colon and rectum in which 54 or 31.2% presented concomitant adenomas associated 11 or 20% of which had undergone malignant change. That there is merit to extending the segment of removed bowel is the report of Acherman who found 33% of his multiple carcinomas to be in the large bowel. To the present, we have transplanted the transverse colon to the anus 21 instances without mortality and in innumerable occasions have anastomosed the transverse colon to the sigmoid in its various portions, yet at the moment, we do not condone the former procedure as routine. Of greater importance is the meticulous lymph node dissection of the pathways and principal gland in continuity.

Perhaps a comment should be made regarding our attitude towards "anterior resection". Suffice to state we have been compelled to discard this procedure from our armamentarium in the curative treatment of cancer of the rectosigmoid because of recurrence.

Anterior resection or rectosigmoidectomy as the term implies certainly approaches the ideal. It is executed easily and there is but little bowel and genito-urinary disturbance or impairment of function. However, as instances of recurrence were encountered in the pelvis and at the suture line, an earnest effort was made to extend the degree of radicality. A wide expanse of mesosigmoid and upper meso rectum was included in the dissection. The rectum was mobilised posteriorly to the coccyx tip well down anteriorly into the septum or to the base of the prostate. Too, the lateral ligaments were divided close to the all of the pelvis. Superiorly, the node bearing area from the third portion of the duodenum was cleared. The inferior mesenteric artery was ligated at its origin and the axilla of the abdomen which includes all nodes in the immediate vicinity was stripped clean. The dissection was continued downward over the vena cava on to the iliacs, to the promontory and into the pelvis as only part of our attack. The bowel above was mobilised as far as the splenic flexure, we left 8 or at least 6 cm. below the lower edge of the growth. During the past few years we have altered or changed from silk to catgut to wire for anastomosis and even employed

stout silk above and below the growth as suggested by Cole in an effort to localize and prevent dislodgement of the cancer cells during manipulation. In spite of these added precautions, and with sincere misgivings we have discontinued anterior resection for frang malignancy of the rectosigmoid junction.

Cancer of the Rectum and Rectosigmoid: It has been our custom during the past fourteen years to remove all cancerous lesions of the upper rectum and rectosigmoid by the technique "Proctosigmoidectomy" in which the anal sphincters are preserved so that a colostomy is not required. Based on the work of Sauer in our Department which confirmed the original investigations of Villmenin, Huard and Montague in 1925 and those of Olivera in 1947, we feel that the operation is well chosen since these studies evidence the fact that the rectum is divided into two distinct lymphatic areas. So that the degree of radicality is in no way impaired providing the lower lymphatic divergent network is not approached. From a histopathologic standpoint the work of Westhues may be cited. Finally our "survival" and "cure" rates in terms of five and ten years compare favourably with those removed by the method of Miles. At a previous date we reported an incidence of 52.6% five year survival and recently Waugh cited a rate of 51.1%.

We have performed this operation in 595 patients for cancer. Our mortality rate is computed at 3.9%. With proctosigmoidectomy as well as in the Miles operation, the descending colon is mobilised as far as the splenic flexure, reliance for viability being placed on the marginal artery of Drummond. Mobilisation of the splenic flexure is seldom required. In all cases for cure, an abdominopelvic lymphadenectomy is performed from the third portion of the duodenum downward into the pelvis. The adventitia of the vessels is opened in such a manner as to follow the proper cleavageplane in order that all cellular tissue can be dissected out along with the contained lymph bearing area.

Wide removal of lateral ligaments or lateral pedicles is affected. The operation is as radical as the method of Miles except the anal and perianal skin is not excised nor is all the ischiorectal fat removed. Neither is a factor since these areas are involved only in those situated below 7 cm. level.

Cancer of the Low Rectum: One cannot refute the statement that the prognosis of cancer of the low rectum is less favourable than in its upper or cephalic portion. All are well acquainted with the popular method of

Miles, yet if better results are to be obtained it is essential that the scope of this operation be extended. Attention is called to several points evidencing the lack of radicality in the Miles operation as usually performed. The abdominal colostomy is placed well below the umbilicus.

Criticism: Such a colostomy in this site means that the midsigmoid portion has been selected as an end-colostomy instead of the mid-descending colon: the blood supply has been divided probably between the first and second sigmoidal branches or even below instead of at the aortic origin of the inferior mesenteric artery.

The paracolic incisions are made usually hugging the bowel in order to obtain a large peritoneal flap for closure.

Criticism: Wide excision of the peritoneum is required, yet is seldom performed since the operator is usually more concerned with closure of the pelvic floor than with the degree of radicality. Closure can be effected by extensive liberation of the peritoneum with the fingers as needed. The dissection should be carried out lateral to the endopelvic fascia for removal rather than medially as in the classic procedure. Should there be any question that this step compromises radicality a pelvic floor is not made but rather a large Milulicz's pack (rubber dam and vaginal gauze packing) is placed in the pelvic to be removed completely 8-9 days later. Dr. Trimpi and I have instituted this procedure in 46 instances without herniation of small bowel or any other complication. Appleby of Vancouver has not established a pelvic floor during the past ten years. The incision in the recto-uteri or recto-vesical sulcus in the process of anterior mobilization is commonly made in the depth of the sulcus and thereby establishes a cleavage plane which remains in the anterior pedicle or anterior portion of the endopelvic fascia (Dennoy's aponeurosis in the male).

Criticism: The incision should be made one inch above and superiorly on the bladder of uterus so that the anterior pedicle is included in the sections since a common site of residual carcinoma is found to be in this fascia about the seminal vesical.

The lateral ligament or pedicles are divided close to the bowel.

Criticism: For proof of this statement each specimen following operation should be placed on a cork board and carefully examined to determine if the lateral ligaments (middle hemorrhoidal pedicles) are attached or have been

left in the pelvis. The fact that this structure harbours the middle hemorrhoidal vessels which may or may not require ligation is of little consequence but for radicality. It is extremely imperative that each lateral pedicle or ligament be divided flat against the pelvic wall to include the lateral node bearing areas or nodes of Cuneo or Marcille. This statement is substantiated by the work of Collier, Kay and McIntyre who found the lateral area of spread to be involved in 54.5% of their cases in which the cancer was located in the last 3 cm. of the rectum and anal canal. Inspection of the posterior bowel wall from the aortic bifurcation to the depth of the pelvis usually demonstrates various amounts of cellular tissue which contain lymphatic networks. Only structures usually visible are the left ureter and the large vessels.

Criticism: The cellular tissue should be removed from the bony structures so that the shiny and glistening surfaces become prominent. The lateral and middle sacral vessels readily become discernable as well as the lattice-work arrangement of the presacral vessels.

While not a criticism it may be mentioned that bleeding will be encountered when the internal ileum arteries are bilaterally ligated distal to their superior gluteal branch. In all Miles operations the senior author (H. E. B.) has instituted this step routinely during the past three years without complication. Appleby has employed it routinely for ten years and Lawrence Abel of London for twenty years. The latter gives Valdoni credit for its use, although according to Keyes quoting Pfeiffer and Ravdin quoting Kirsner queneue cited his experiences with internal iliac ligation in 1896. In the perineal portion of the operation after the cancerous bowel segment is removed, the levator ani muscles are approximated by suture and the perianal skin is sutured anteriorly and posteriorly except in its central portion into which a wick is introduced for drainage.

Criticism: Assuming the operation was performed for a cancer lying at a low level in the rectum, radicality requires an expansive excision of the perianal skin ischio-rectal fat in which event it would be quite impossible to approximate let alone close the skin. Likewise, the levator ani and recto-urethralis muscles in any abdomino-perineal procedure must be removed.

Carcinoma of Anal Canal: For epidermoid or squamous cell carcinoma, the extended abdominoperineal operation and iliopectin lymphadenectomy as performed for low lying rectal cancer obtains with the addition of bilateral inguino-femoral lymph node dissection is instituted 10-14 days later (after the method Baronofsky).

Primary Multiple Malignancy: A few years ago we reviewed our patients with primary multiple malignant tumors and were appalled at the high incidence of primary ovarian cancer namely 11.1% of all females in the series. Except one, all women were in the menopause or post menopausal period. The age of menopause varies with the individual, thus the age when the cessation of estrogenic hormone stimulation occurs is also variable. The relationship between the female sex hormones and carcinoma of the female genital organs and breast is generally appreciated. How much influence the ovarian hormone secretion has upon the development of another primary malignant lesion of the genital tract or breast can only be conjectured but it does raise the question as to the advisability of castration of female patients who have malignant lesions of the rectum or colon concurrently with the removal of the bowel lesion at least in women of this age. In those patients who still have estrogenic hormone activity castration would eliminate the hormonal influence in the development in another cancer of the genitals or breast. During the past four years we have performed bilateral oophorectomy on all female patients over the age of forty at the time of the bowel resection when performed for cure.

Burt has discussed this problem at length but is prone to consider the ovarian carcinomas as distinctly metastatic rather than a primary growth. He advises bilateral oophorectomy when feasible yet in our opinion barring religious scruples and a childless marriage, it may be well chosen as a routine procedure. Deddish found ovarian carcinoma to be present in 8% of his cases for which reason he too advised bilateral salpingo-oophorectomy at the time of resection.

Hysterectomy and Vaginectomy: In advanced lesions of the rectum and rectosigmoid it has usually been our custom to perform a total hysterectomy and we would venture to remark that routine hysterectomies in all patients over the age of 40 and under 65 may be well chosen. With direct invasion or even suspicious involvement of the vaginal wall we have always removed the vaginal tube widely. Quite recently (Knight et al) reported that the five year survival rate of vaginal involvement is 24% or one half the survival rate of patients with lesions of the rectum alone without fixation.

Until the fall of 1948 it was our practice to employ radium and roentgen therapy in the treatment of

(Continued on page 10)

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New Medical Uses of Radio-active Isotopes

BY PROF. J. ROTBLAT

Professor of Physics at St. Bartholomew's Hospital School, London

It was announced recently that radio-active isotopes, produced under Britain's atoms-for-peace plan, are being used in 41 oversea countries, including India.

In the article below, Professor Rotblat discusses the important role of radio-active isotopes as an aid to medicine and surgery. The potentialities of these isotopes as a cheap and portable source of X-rays, says the author, are very great indeed. Every doctor, even in the smallest village, would be able to own an X-ray equipment, needing no supply of electricity and with no maintenance problems.

AN interesting new use for radio-active isotopes has been developed by Professor W. V. Mayneord and his team at the Royal Cancer Hospital, London. Some of the radio-active isotopes of chemical elements being produced in Britain's nuclear energy reactors emit radiations which are very similar to the X-rays commonly used in medical radiography for taking X-ray pictures of various parts of the body. It is now possible to produce high concentrations of these isotopes by putting ordinary substances into an atomic pile and leaving them there for some time.

Such an X-ray source can be of very small dimensions, about the size of a grain of rice, and even with the shielding necessary to make it safe to handle it can be small enough to be carried in a waistcoat pocket. The possibilities arising from such portable and cheap X-ray sources are very great indeed. Every doctor, even in the smallest village, would be able to own an X-ray equipment,

needed no supply of electricity and with no maintenance problems; he would be able to carry it with him to patients or to any place of accident.

RADIATION THERAPY

Another great advantage of these miniature sources is that they make it possible to take unusual X-ray pictures, to obtain views which are otherwise impossible to get. If, for example, an X-ray photograph of the jaws and teeth is wanted the source can be put into the mouth and the photographic film outside the face. In this way a photograph of all the teeth can be obtained at once instead of in several exposures as has to be done now. In a similar fashion the source can be introduced into other cavities and so give the doctor a clearer picture of the organs in the body. One can foresee that in course of time all X-ray tubes will be replaced by the much cheaper and simpler-to-handle radio-active isotopes.

(Continued from page 9)

localised recurrent cancer. The results were extremely discouraging for which reason we instituted a more radical approach in all patients with no residual or suspected recurrence, and in innumerable instances, the results have been gratifying by comparison. However, recurrence in the presence of liver metastasis is seldom worthy of resection in our opinion. Regarding the

practice of "Second-look" as recommended by Wangenstein, we have not been too critical as others have been; in fact we look upon the procedure with some degree of favour since in a few instances it has proved worthwhile for the patient. However, we would not be willing to go so far as to perform or recommend its performance as a routine measure in all cases.

"What's your trouble, Madam?" asked a Doctor of the fretful lady.

"I want to know is there any cure for flat feet" she stated.

"Yours?"

"No, my husband's. If there is n't, I'll have to divorce him". "That seems strange. Perhaps he can't help his flat feet".

"He can," she stated menacingly; "he always has his feet in the wrong flat".

In therapy, too, radio-active isotopes are gradually replacing X-ray tubes. In this case use is made of the destructive action of the radiations sent out by the radio-active isotopes to kill malignant cells. Several large therapy units, in which radio-active cobalt or caesium are employed instead of X-ray tubes, are already in existence in Britain.

The main problem in radiation therapy is to be able to discriminate between healthy and diseased tissue and the ideal is to destroy only the latter while affecting very little the former. In a few isolated cases this became



Examining a patient in a United Kingdom hospital by means of radio-active isotopes produced at Britain's Atomic Energy Research Establishment at Harwell in the English county of Berkshire. A highly directional Geiger counter held by a nurse is used to follow the distribution of radio-active iodine in different parts of the thyroid gland.

possible with radio-active isotopes used internally. Thus, radio-active iodine concentrates in thyroid tissue, and in cases of cancer of the thyroid gland, even when it has reached the stage when secondary growths have appeared in various organs, it is possible to destroy the

malignant tissue wherever it is merely by giving the patient a drink of water containing radio-active iodine.

FOR TREATING LUNG CANCER

In other kinds of cancer, however, such natural concentration of the radio-active isotope has proved impossible, and special means have to be taken to localize the therapeutic agent in the diseased organ. An important contribution, which opens the possibility of treating cancer of the lung, has recently been made by a group of medical scientists working at the University College Hospital, London, under Dr. E. E. Pochin. They employed radio-active material in the form of a colloidal suspension of particles of such size that when injected into the blood-stream the particles are carried by it until they reach the capillaries of the lungs where they get stuck.

Colloidal gold is precipitated on to sugar charcoal particles about 30 to 40 microns in diameter, and put into the atomic pile where a radio-active isotope of gold is produced. The particles are then suspended in a dextran solution, which is injected into the patient. It is possible to deposit the radio-active particular region of the lung. This method of treatment has so far been tried out in a few cases only and more research is needed before it finds general application.

Apart from these applications in which large quantities of radio-active isotopes are used, there are many other problems in which minute amounts of isotopes are used as tracers, particularly in the study of the working of various organs in the body. Such tests are used as aids in medicine and surgery.

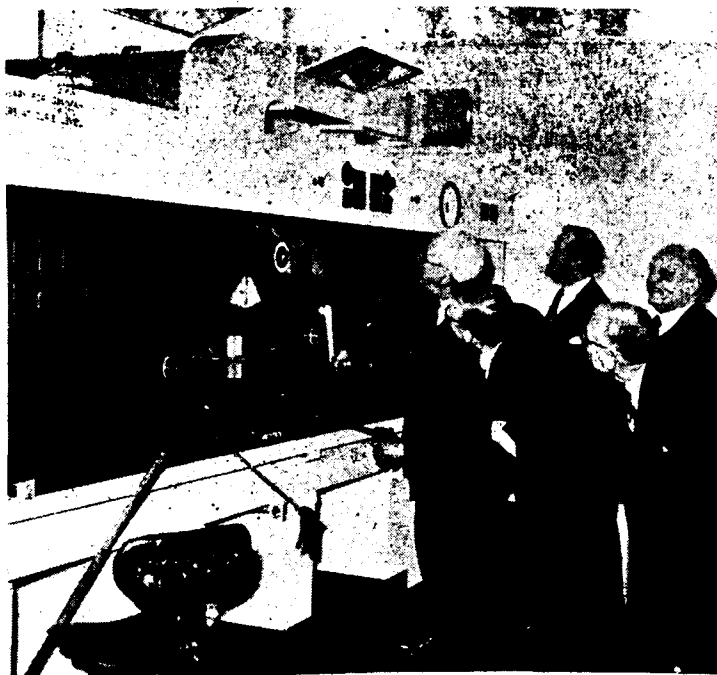
An interesting application to skin grafting has been made in the Plastic Surgery Centre at Salisbury, in Southern England. In many cases of burns, or other skin damage, it is necessary to apply a number of grafts over a period of weeks. If skin grafts could be successfully stored, then one surgical operation might be sufficient for all subsequent grafts, but the difficulty has been to find out whether skin stored for a certain time is still viable. This was solved very simply by incubating sections of the skin in radio-active phosphorus and measuring the activity taken up by the section.

AID TO DIAGNOSIS

Dead skin does not take up phosphorus, while skin which is still functioning does. In this way the best methods of storage of skin grafts could be found. This

is only one example of the uses of radio-active phosphorus in plastic surgery which have already greatly contributed to shortening the time, and to the successful outcome, of such operations.

For other tests the radio-active isotope is often synthesized into organic compound which are natural constituents of the body. Radio-active iodine, for example, can be incorporated into the plasma proteins, and when such plasma is injected into a blood vessel of the patient,



Britain continues to lead the world in producing radio-active material for peaceful international use. To cope with the growing demand from home and abroad for these valuable materials, so important in medicine, science and industry, a number of new buildings have been added to the British Radio-chemical Centre at Amersham, near London. Here Sir Henry Dale, O.M., F.R.S., is seen sealing a bottle by remote control containing radio-active phosphorus when he opened the extensions to the Centre. The bottle was later flown to Brussels where its contents was used to treat a patient suffering from a blood disease. In the picture are left to right: Sir Henry Dale, Sir John Cockcroft, Sir Charles Harington, Sir Ernest Rock Carling and Major G. Boyce.

it mixes perfectly with the blood; by following the activity one can then find out what is going on in the circulatory system. Several London hospitals are using this method as an aid in diagnosis of various diseases of the heart and blood circulation. In particular, it is used to measure the cardiac output, the amount of blood which the heart pumps every minute, a quantity of extreme importance in the assessment of circulatory disorders.

These are but a few examples of the recent advances in the applications of radio-active isotopes to medicine, but they may serve as an illustration of the great scope and versatility of this new method of using nuclear energy for the benefit of man.

INDIA TAKES 44 CONSIGNMENTS IN ONE YEAR

Britain's world lead in the peaceful uses of atomic energy is increasing steadily. Radio-active isotopes produced under her atoms-for-peace plan are now speeding intricate processes and cutting costs in factories and laboratories in 41 countries, including India. This was revealed by Dr. Henry Seligman, Director of the Isotopes Division at the Atomic Energy Research Establishment at Harwell, opening a special exhibition in Birmingham.

The exhibition demonstrates the most up-to-date applications of isotopes in research and industry, and Dr. Seligman said that Britain was competing successfully in world markets with these valuable atomic products. In terms of volume and cost, British exports of these materials were greater than those of all other countries put together.

Production of radio-active isotopes in Britain has doubled in the past two years. A spokesman of the Atomic Energy Authority disclosed in London recently that year's total amounted to about 20,000 shipments; and at the Birmingham exhibition Dr. Seligman said that the U. K. last year exported 6,000 consignments. Detailed figures for 1954 have not yet been released. But between October 1953 and September last year, Britain's production of isotopes totalled well over 15,000 shipments—of which exports amounted to over 5,000 shipments.

* * * * * *

France was the largest importer during that period, with more than 1,100 consignments. Of the Commonwealth countries, India took 44 shipments, Pakistan one, Ceylon two, Australia 96, Canada (herself a large producer of isotopes) 26, the Gold Coast three, Mauritius three, New Zealand 100, South Africa 152, Southern Rhodesia one, Zanzibar one. The U. S. A. took 35 consignments of these important materials.

MEDICAL USES EXTENDED

Of consignments released for use in the U. K. last year, it is estimated that about half were taken by hospitals

and medical research centres. Parallel with the increasing commercial exploitation of isotopes, there medical uses are being extended, especially in the treatment of some types of cancer.

In the industrial field, as Dr. Seligman remarked, "isotopes are becoming an integral part of new developments in production and research. They can be said to represent the most important single discovery since the invention of the microscope".

The Birmingham exhibition shows a wide range of the industrial applications of radio-active isotopes. It dis-

plays instruments for radiographic examination to check the quality of castings, welds and forgings; gauges for detecting leakages in liquid systems, for thickness measurement on continuous production of sheet material; methods for ascertaining the wear of moving parts and bearings, for measuring filter efficiency, tracing mud movement in estuaries, and for following the work of machinery out of sight underground.

An isotope held in a spigot about one inch in length and housed in its permanent home—a protective lead case with a shutter for filming the product—is capable of replacing a costly 1,000,000-volt X-ray plant.

James Whitcomb Riley was an itinerant roadside sign painter. Frequently he travelled with a patent-medicine agent in a horsedrawn buggy. One day they came to a smoothfaced rock where an Evangelist had painted WHAT SHALL I DO TO BE SAVED?

Riley crawled up the rock and painted underneath: "TAKE BARLOW'S STOMACH BITTERS".

Returning to the spot two weeks later Riley noticed that the Evangelist had added a new line: "AND BE PREPARED TO MEET THY GOD".

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Aluminium Hydrox- gel dried	gr. 4
Phenobarbitone	gr. 1

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- * Hypertension

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TOXICOLOGY OF PLASTICS AND RUBBER

PLASTOMERS & MONOMERS

BY DR. REX H. WILSON, M.D., F.A.C.P.,

AND

DR. WILLIAM E. MCCORMICK, M.S.

THE popular demand for all types of articles made from plastics has been so tremendous that literally there has been created an entirely new industry in the past several years. Many plants large and small, are devoting their entire manufacturing facilities to "Plastic" items. The demand for the compounds going into the composition of the plastic materials is so great that supplies of certain of them are short.

Because the industry is new and because of the ingenuity of modern research, the compounds making up the plastics are ever changing. Also, as demands for different types of articles made from plastics are increasing this creates a demand for different types or kinds of plastics. (Table 1).

TABLE 1

Common Plastics	Uses	Properties
Acrylics	Aircraft turrets, auto tail lights, brush backs, signs, (Dynel, Acrilan, Orlon textiles)	Optical clarity, good weather resistance, wide colour range, shatter resistance, machinability.
Alkyds and Rosin Modifications	Linoleum surfacings, paints for refrigerators and autos ignition parts, magneto rotors.	Fast curing, good dimensional stability, good electrical insulation, good heat resistance.
Aminos (Urea and Melamine)	Buttons, dishes, laminated table tops, housings for kitchen appliances.	Unlimited colour range, good electrical insulation, resistance to organic solvents.
Cellulose plastic Materials	Display packaging, irrigation pipe, frames for eyeglasses (rayon & acetate textiles).	Toughness, high impact strength, ease of fabrication, lustrous finish, good electrical insulations.
Coumarone-indene & Petroleum Resins	Asphalt floor tiles, aluminium paints, waterproof coatings, printing inks.	Resistance to water and caustic cleansers, compatibility with compounding ingredients, glass.
Fluorocarbons	Pump diaphragms, chemical tubing, high temperature insulation.	Extreme resistance to corrosive agents and solvents, wide temperature range, high impact strength.
Epoxyes	Printed circuit backing, adhesives, surface coatings transformer & motor laminates.	Excellent adhesion, resistance to chemicals, and heat, can be cured at room temperature.
Nylon	Gears, slide fasteners, combs, tumblers, tennis racket strings, (nylon textile).	Good strength and toughness, over wide temperature range, wear resistance, self lubricating.

TABLE 1

Common Plastics	Uses	Properties
Phenolic and other Tar Acid Resins	Telephone handset, radio-TV cabinets, shell molding dials, grinding wheels, plywood.	Hard and rigid, good temperature range, strong good electrical insulation, low water absorption.
Polyethylene	Squeezeable bottles, semi-rigid kitchenware, packaging, coaxial cables.	Inert to solvents, flexible and tough over wide temperature range, non-toxic, odorless, tasteless.
Polyester Resins	Reinforced plastics for auto bodies, boats, translucent panels (Dacron textiles)	Weather resistance, can be formed with low pressure, strong colourful, compatible with many fillers.
Silicones	Insulation for generator coils, auto polishes, waterproof coatings, circuit breakers.	Extreme heat resistance, low water absorption, good dielectric properties over wide frequency range.
Styrene Resins	Kitchen housewares, refrigerator parts, toys, novelties, wall tiles, lighting fixtures.	Lightest of commercial plastics excellent moldability, unlimited colour range, tasteless, odorless.
Vinyl Resins	Floor tile, packaging film, rainwear, toys, upholstery materials, pipe and pipe fittings, valves, electrical insulation, sponge, machine and structural parts, metal and fabric coatings.	Tough and strong unlimited colour range, excellent electrical insulation, resistance to chemicals, oil and weathering.

Naturally, the kind of material needed for a plastic automobile body is different from the material needed for an elastic garden hose or a pair of stockings. I know of no other industry which better represents the creative genius of man than the so-called plastic industry. The creation at less cost of better things for better living is the aim of the modern business man. To achieve this, there have been brought into existence the wonderful modern-day research laboratories.

It is important to know the chemical properties of a compound and its toxicity. It is also important to know how to work with it safely. Equally important is to know the treatment for overexposure to the toxic chemical to prevent permanent damage or death.

It would be impossible to name, let alone discuss, the toxicological properties of all of the chemical compounds being used in the plastic industry. It is worth-while to discuss the properties of some of the more common resins, plasticizers, stabilizers and solvents being used. Unfortunately, the toxicological properties of all of these are not too well defined. It is to the credit of people working in industrial medicine and hygiene that industry

is becoming aware of the necessity for knowing the toxicity of its materials and is taking steps to ensure that its employees are not exposed to materials that would harm them.

RESINS

Lehman in July, 1951 presented a list of resins both suitable and unsuitable for use as food packaging ingredients. He stated "that as a general rule resins are so insoluble as a class that the chances of contamination by the solvent action of foods are rather slight". The types of resins he considered suitable for food use are :—

Polyvinyl chloride.

Polyvinyl acetate.

Polyvinyl chloride-acetate.

Polyvinylidene chloride.

Polyethylene.

Cellulose acetate.

Regenerated cellulose.

Terephthalic acid-ethylene glycol copolymer.
Butadiene-acrylonitrile (Perbunan or Hycar synthetic rubber).

Lehman classified as being unsuitable for use in food packages because of the lack of adequate data concerning their toxicity :

Polyvinyl formal.
Polyvinyl acetal.
Polyvinyl butyral.
Polymeric furfuryl alcohol.
Coumarone-indene.
Urea formaldehyde.
Phenol formaldehyde.
Aniline formaldehyde.

A. VINYL TYPE

Vinyl chloride, vinylidene chloride and vinyl acetate readily polymerize. By proper combinations of one or more of these monomers many polymer variations can be

produced. These polymers, after properly mixing with plasticizers and stabilizers, are then used in hundreds of different items. The three polymers, either individually or associated with each other, are relatively non-toxic.

Seeler and associates studied the chronic toxicity of a copolymer of vinyl and vinylidene chloride. This work was done because the copolymer was being considered for use as a constituent of a plastic film for wrapping food products. They reported that rats fed a diet containing 5% vinyl and vinylidene chloride copolymer for two years showed no toxic effects. Two dogs were fed a diet containing 5% vinyl and vinylidene chloride copolymer without evidence of toxic effects.

Some toxicological information also exists on the three monomers-vinyl chloride, vinylidene chloride, and vinyl acetate. Patty, Yant and Waite investigated the acute effects of vinylchloride on experimental animals and found this to be essentially narcosis. Carpenter and associates in range finding studies observed that a vapour concentration of 32,000 ppm. of vinylidene chloride resulted in a portion of deaths of the six rats exposed for our hours. The vapour toxicity is reported to be of the

same order as ethylene dichloride. Carpenter and associates also reported a level of 4,000 ppm. of vinyl acetate produced some deaths under the same conditions.

B. ACRYLONITRILE-BUTADIENE TYPE

Various types of American made rubbers have been studied physiologically. Among those found to be acceptable for food use are Perbunan and Hycar (polymers of acrylonitrile and butadiene). However the manufacture of these items does present some health problems.

Wilson and associates reported on the toxicity of acrylonitrile in 1948. They stated that, in their observations, workmen handling cleaning operations in polymerizers with exposures varying from 16-100 ppm. for 20 to 45 minutes frequently show symptoms of dull headache, fullness in the chest, irritation of all mucous membranes including the eyes, nose and throat, and a feeling of apprehension and nervous irritability. Some workmen complained of intolerable itching of the skin contact with no demonstrable dermatitis. Direct skin contact with acrylonitrile causes irritation and erythema followed by bleb formation, desquamation and slow healing. Wilson reported several cases of acrylonitrile poisoning in which there developed mild jaundice, low grade anemia and leucocytosis. Given orally the minimal fatal dose of acrylonitrile in laboratory rats is stated to be 150 mg/kilo body weight. Symptoms in these animals included respiratory changes, cyanosis, convulsions and death.

Because the mode of action of acrylonitrile in the human system appears to be similar to that of cyanide, the treatment of overexposure to acrylonitrile was outlined by Wilson and associates to be the same as that for overexposure to cyanide. This treatment was proved to be life saving in several instances.

Vitamins B₁ and C have been found to be beneficial in preventing weight loss in laboratory animals exposed to acrylonitrile over long periods.

Wilson and associates also suggested as a prophylaxis against overexposure to acrylonitrile that atmospheric concentrations should not exceed 20 ppm. This necessitates enclosure of processes to the maximum degree possible and the effective use of mechanical exhaust ventilation.

Skin contact should be avoided, not only because of the compound's vesicant action, but also because of possible toxic systemic effects. In the case of skin contact with the concentrated compound, immediate

washing with copious quantities of soap and water is necessary. If spilled on clothing, the clothes should be immediately removed and a shower taken by the individual. The effect of chronic low-grade atmospheric or skin exposures on humans is still undetermined. It is, therefore, advisable that working personnel be given periodic physical examinations, with special emphasis on hematology and liver and kidney functions. The determination of the thiocyanate level in both blood and urine has been suggested as an index of overexposure.

Wilson and associates also reported on the toxicology of butadiene. They stated that butadiene is practically innocuous, aside from its narcotizing and anesthetizing effect at very high concentrations. Human subjects who were exposed to 8,000 ppm. of butadiene complained of eye irritation, blurring of vision, coughing, nasal congestion, and drowsiness. Subsequent repeated exposures gave no indication of cumulative action.

A complete examination of the chest including an x-ray, blood examination and urinalysis were not informative. Subsequent follow-up examinations were also negative. In laboratory animals subjected to high exposures of butadiene, irritation of all of the mucous membranes and respiratory tract occurs along with varying degrees of narcosis. Acute deaths are due to chemical pneumonia following pulmonary irritation. Experimentation with butadiene in laboratory animals indicates that butadiene is not a safe general anesthetic because there is not complete muscular relaxation even in the fourth stage. Death ensues rapidly when the laboratory animal is kept in deep anesthesia for any length of time.

Wilson and associates stated that workmen anesthetized with or suffering from exposure to butadiene should recover completely, providing they are removed from exposure while respiration and heart action are still strong. Oxygen by inhalation should be administered until the pulse and blood pressure remain normal and the colour is good. Symptomatic treatment is indicated.

Special precautions need to be observed in handling the compound from a fire and explosive standpoint. These include enclosure and mechanical exhaust ventilation and will in most cases automatically control the health hazard. There is no apparent systemic injury to humans in concentrations below 5,000 ppm. Any complaints which include eye and respiratory irritation, headache and vertigo might be considered as indicative of excessive exposure.

R. S.—51

IN ESSENTIAL HYPERTENSION

The fall of Blood pressure is noticeable both in the systolic and diastolic blood pressure.

I. M. G. Vol. LXXXVI, No. 8 (August 1951)

Fall in Blood Pressure both systolic and diastolic, was registered in all cases. In some the effect was noticed in 24 hours while in others it took 48 to 72 hours to lower the pressure.

I. J. M. S., Vol. 8 No. 5 (May 1954)

Even though in some cases, the pressure had fallen over considerable figures, patients did not seem to be affected in any way.

THE ANTISEPTIC, Vol. 51; No. 11 (Nov. 1954)

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C. MISCELLANEOUS TYPES

Some of the newer synthetic resins which have been physiologically studied are the silicones, the polyethylene glycols (carbowax compounds), and teflon (polytetrafluoroethylene). Rowe ET AL found upon feeding guinea pigs for 50 days in amounts up to 3% of the daily diet no indication of toxicity with DC resins 993 and 2102. They also found that DC Pan Glaze possessed a very low order of oral toxicity when fed to the rat. Shaffer and Critchfield concluded from their study of carbowax compounds 1,000, 1,540, 4,000 and 6,000 that no significant gastrointestinal absorption occurred when fed to rats. They also administered intravenously compounds 1,000 and 6,000 to humans and found they were readily excreted to a high degree.

Polytetrafluoroethylene (Teflon) is a synthetic resin with exceptional resistance to both heat and chemicals. It is being used for electrical insulation, for special types of tubing, for coating molds and bread pans, and for gasket materials in jet engines. Stokinger has described the ill effects which may result when Teflon is heated to about 360 degrees F. as well as from exposure to the finely divided polymer itself. These effects resemble, in the case of the sublimate (resulting from heating the polymer) those of hydrogen fluoride poisoning. In using Teflon, adequate ventilation is necessary to avoid ill effects. Lehman reports that baking tests have shown no significant increase of the fluoride level of bread baking pans which have been coated with Teflon.

PLASTICIZERS

Lehman in July, 1951 stated that plasticizers presented more serious toxicological problems than the resins because there is always the possibility that these materials may be leached out by food substances. The plasticizers which have had adequate pharmacological study demonstrating their harmlessness in the amounts now used in finished commercial films are:

Ethyl Phthalyl ethyl glycollate.
p-tertiary Butyl phenyl salicylate.
3-(2-Xenoxyl)-1,2-epoxypropane.
2-Ethylhexyl diphenyl phosphate.
Butyl phthalyl butyl glycollate.
Glycerol monooleate.
Acetyl tributyl citrate.
Di-iso-butyl adipate.

Lehman classified as unsuitable for food use the following:—

Dicyclohexyl phthalate.
Dibutyl phthalate.
Methyl phthalyl ethyl glycollate.
Di-iso-octyl phthalate.
Dioctyl adipate.
Dibutyl sebacate.
Dioctyl sebacate.
Dicapryl sebacate.

Seifter in 1943 made acute toxicity, chronic toxicity and skin irritation studies on dibutyl phthalate. His summary and conclusions were:—

1. Dibutyl phthalate is a mild primary skin irritant for animals and humans.
2. Dibutyl phthalate taken by mouth is acutely toxic.
3. Dibutyl phthalate ingested daily over long periods of time in amounts up to 2.5 gm. per kilogram of diet, does not produce chronic poisoning.

Smith studied dibutyl phthalate and found the acute lethal oral dose to be about 8 gm. per kilogram. When administered chronically in the diet the maximum concentration which did not significantly reduce normal growth was 0.25%. The feeding of dibutyl phthalate even in highest dietary concentrations did not provoke specific gross or microscopic pathologic changes. His findings also suggested that dibutyl phthalate was metabolized in the body in much the same way as the fat normally ingested in the diet. He did not feel that it was safe to incorporate dibutyl phthalate in films for wrapping foods even if the calculated safety factor was in excess of 1400.

Seifter in studying dicapryl phthalate made the following summary and conclusions:

1. Dicapryl phthalate is not a primary skin irritant for animals or humans.
2. When taken by mouth dicapryl phthalate has a low acute toxicity.

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Steclin is the newest broad-spectrum antibiotic.

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The range of clinical usefulness of Steclin is similar to that of oxytetracycline and chlortetracycline. It is often superior to its analogs because therapeutic blood levels are achieved with fewer gastrointestinal side effects.

As with all broad-spectrum antibiotics, overgrowth with non-susceptible organisms, particularly monilia, may occur.

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Manufacturers & Distributors of Squibb Products in India.

3. Ingested daily overlong periods of time, in amounts up to 2.5 gm. per kilogram of diet, dicapryl phthalate does not produce chronic poisoning.

Seifter in 1943 came to the following conclusions concerning triethylene didecoate :

1. It is not a primary skin irritant for animals or humans.
2. When taken by mouth, it has a low acute toxicity.
3. Ingested daily overlong periods of time in amounts up to 2.5 gm. per kilogram of diet, it does not produce chronic poisoning.

Smith found that the acute lethal oral dose of butyl stearate was greater than 32 gm. per kilogram. When butyl stearate was administered chronically in the diet, the maximum concentration which did not significantly reduce normal growth was more than 6.25%. Butyl stearate in the highest dietary concentration did not provoke specific gross or microscopic pathologic change and in dietary concentrations of 6.25% had no adverse effect on fertility or the number of viable young in the litter. There was in this concentration slight retarded growth of the young. He felt that, based on the above data butyl stearate when incorporated in films for wrapping food appeared to possess little, if any, potential hazard for humans, the calculated safety factor being in excess of 1,400.

Smith came to the conclusion that the acute lethal oral dose of methoxyethyl oleate was approximately 16 gm. per kilogram and when administered chronically in the diet of rats the maximum concentration, which did not significantly reduce normal growth, was 0.01% to 0.05%. He found renal calculi in three of seven rats fed 1.25% methoxyethyl oleate for more than six months. He felt that methoxyethyl oleate was hydrolyzed by pancreatic lipases as rapidly as triolein. He did not feel that methoxyethyl oleate should be incorporated in films for wrapping food.

Smith concluded that the acute lethal oral dose of dibutyl sebacate was between 16 and 32 gm. per kilogram and that when administered chronically in the diet of rats, the maximum concentration which did not significantly reduce normal growth was 6.25% and that when fed in the highest dietary concentration, there were no specific gross or microscopic pathologic changes. Dibutyl sebacate in dietary concentrations of 6.25% had

no adverse effect on fertility or the number of viable young in the litter. It did cause a slight retarded growth of the young. Smith felt that this plasticizer was metabolized in the body in much the same way as fat normally ingested in the diet, and that when it was incorporated in the films for wrapping food appeared to possess little if any, potential hazard for humans, the calculated safety factor being in excess of 1400. Mallette and Von Haam state that dibutyl sebacate is a non-toxic plasticizer, with no irritating or sensitizing effect on the skin, and that dibutoxyethyl phthalate is a non-toxic plasticizer with no irritating or sensitizing effect on the skin.

Mallette and Von Haam listed the following as non-toxic plasticizers :—

- Di-2-ethylhexyl adipate.
- Dibutyl cellosolve azelate.
- Cyclohexyl azelate.
- 2-ethylhexyl azelate.
- Methyl isobutyl carbinol azelate.
- Pentanol azelate.
- Diethylene glycol dicaprate.
- Dibutoxyethyl diglycol carbonate.
- Octadecene nitrile.
- Dibutoxyethyl phthalate.
- Dicapryl phthalate.
- Methylacetyl ricinoleate.
- Dioctyl sebacate.
- "Plasticizer 50 B" (Barrett).
- "Plasticizer SC" (Drew).
- "Plasticizer Ellicott H."
- "Paraplex G-25" (Rohm & Haas).
- "Paraplex G-40" (Rohm & Haas).
- "Plastolein X-55" (Emery).

They stated that five of the plasticizers examined showed a moderately toxic effect in laboratory animals. They were dioctyl phthalate, butylbenzyl phthalate, "santicizer 140," "santicizer 141," and "flexol 8N8."

Di (2-ethyl hexyl) phthalate (commercially referred to as dioctyl phthalate, DOP, and 2-ethyl hexyl phthalate) was studied by Hodge with respect to acute oral and intraperitoneal toxicity in rats and mice. He concluded that it had a very low order of toxicity. Shaffer,

Carpenter and Smyth studied it in 1945. Their conclusions were that the health hazards involved in its use as a plasticizer are slight. Such injurious action as it does exert within the body appears to be due to the alkyl part of the molecule rather than to the phthalate portion.

Mallette and Von Haam found that dioctyl phthalate had a moderately toxic effect in laboratory animals and that the intraperitoneal injection of dioctyl phthalate proved fatal in doses higher than 2 gm. per kilogram of body weight. Lower doses produced weight loss, leucocytosis, severe anemia and hematuria from which the animals recovered after a month or two. No delayed effect or permanent injury was noted in the surviving animals. They also showed that dioctyl phthalate had a moderate skin irritating effect.

Carpenter, Weil and Smyth reported the results of feeding Di (2-ethyl hexyl) phthalate for two years to rats and for one year to both dogs and guinea pigs. They obtained relatively uniform responses from all three species, with the two-year "no-effect" level for rats falling between .06 and .20 gm. kilogram per day, and the one-year "no-effect" level for both dogs and guinea pigs approximating .06 gm. per kilogram per day.

Lehman reports that food packaging films containing this compound as a plasticizer are satisfactory for wrapping foods with a high water content, but are unsatisfactory for use with foods having a high fat content, because of the ready solubility of the plasticizer in fats and oils. Halpern and Weiss found no irritation or induced Sensitivity with vinyl film containing dioctyl phthalate as the plasticizer.

In 1952 Mallette and Von Haam reported on other plasticizers, several of which they found to be moderately toxic to rats in acute exposures. They were :—

1. Butylbenzyl phthalate was fatal in rats after intraperitoneal administration of doses higher than 1.8 gm. per Kilogram of body weight. Oral administration of more than 4. gm. per kilogram of body weight proved equally fatal. The animals died after four to eight days, showing weight loss, apathy and leucocytosis. The histological examination of the organs revealed toxic splenitis and degenerative lesions of the central nervous system with congestive encephalopathy, myelin degeneration and glial proliferation.

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2. "Santicizer 140" (monotolylidiphenyl Phosphate) proved fatal in intraperitoneal doses of higher than 1 gm. per kilogram of body weight. Oral doses up to 4. gm. were supported. Toxic animals became lethargic on the second or third day and a profuse diarrhea developed. They died with symptoms of paralysis. Autopsy showed a generalized capillary paralysis with severe edema and numerous hemorrhages in the brain.
3. "Santicizer 141" (2-ethyl hexyl diphenyl phosphate or mono octyl diphenyl phosphate) killed animals after intraperitoneal administration of doses higher than 2.4 gm. but oral administration of 4. gm. per kilogram of body weight was tolerated. With the intraperitoneal administration the animals became paralyzed and lethargic. Recovery from non-fatal lesions was delayed. The histopathological examination demonstrated a severe acute hemorrhagic encephalopathy with cerebral edema, ganglion cell degeneration and small hemorrhages. As delayed effects, focal gliosis and persistent foci of myelin degeneration could be observed. Large fatal doses also proved a powerful hemolytic agent with marked vascular hemolysis, hemoglobinuria and hemosiderosis of the spleen.
4. "Flexol 8N8" (N, N-di-beta-(2-ethylhexyl) ethyl 2-ethyl hexylamide) proved fatal in doses higher than 4. gm. per kilogram of body weight. The animals developed convulsions followed by paralysis. The histological examination of the brain gave the picture of toxic hemorrhagic encephalopathy with edema, swelling of ganglion cells and small hemorrhages.

Their conclusions were that these four plasticizers proved moderately toxic in doses from 0.6 to 2.4 gm. per kilogram of body weight. The toxic reaction was displayed by the erythrocytes, the blood capillaries and the central nervous system. They also found in their studies 17 plasticizers to be slight or moderate skin irritants. Three—"Flexol 8N8," "Paraplex G-25" and "Paraplex G-40"—proved to be severe skin irritants.

A moderate sensitizing effect on the skin was found by Mallette and Von Haam to exist with diethylene glycol

dicaprate, methylacetyl, ricinoleate, "Paraplex G-25" "Paraplex G-40" and "Santicizer 140".

Seeler et al in their studies on the chronic toxicity of acetyl tributyl citrate, came to the following conclusions:

1. Rats showed no toxic effect after eating diets containing 200 ppm. 2,000 ppm. and 20,000 ppm. of acetyl tributyl citrate for two years.
2. Dogs were given a daily oral dose of 140 mg. of acetyl tributyl citrate of two years without evidence of toxic effect.

Seeler et al, on making chronic toxicity studies of butyl phthalyl butyl glycolate came to the following conclusions:-

1. Rats fed diets containing 200 ppm. 2,000 ppm. and 20,000 ppm. of butyl phthalyl butyl glycolate for two years showed no toxic effect.
2. Dogs were given a daily oral dose of 140 mg. of butyl phthalyl butyl glycolate for two years without evidence of toxic effect.

The results of both acute and chronic oral feeding, as well as skin absorption and irritation with 2-ethylhexyl diphenyl phosphate (Santicizer 141) are given by Treon et al. These investigators found the compound to be innocuous when administered orally to rabbits and rats in a single large dose. No effects, either irritative or systemic were found as the result of keeping it in contact with the abraded skin of rabbits for seven to 24 hours. Rats fed for two years on a diet containing 1%, 0.125% and 0.0625% by weight of the compound showed no pathology, but did show a retarded growth rate at the 1% level. Dogs fed with the compound at dietary levels of 2.5% for two years showed retarded growth, but those fed a 1.5% level grew normally.

Treon, Cappel and Sigmon have found that a high percentage of Santicizer 141 are not irritating and do not induce sensitivity in humans.

STABILIZERS

Many different materials are being used as stabilizers for plastics. The specific type of plastic with particular reference to its use, governs to a large degree the stabilizer to be selected. Obviously, uses such as that of food packaging where there might be leaching of the stabilizer

into the food require materials that are not harmful if ingested. Lehman states that the following are not objectionable for food packaging:

Aluminum monisterate.
Calcium acetate.
Calcium carbonate.
Calcium carbonate.
Calcium stearate.
Calcium glycerophosphate.
Mono-di-and tricalcium phosphate.
Calcium oleate.
Calcium ricinoleate.
Magnesium glycerophosphate.
Mon-di-, and trimagnesium phosphate.
Disodium hydrogen phosphate.
Ammonium potassium phosphate.

Some of the most efficient stabilizers from the standpoint of performance, particularly for the vinyl resins, are the heavy metal salts of barium, strontium, lithium, cadmium and lead. All of these compounds, however possess a relatively high degree of toxicity and they are objectionable for use in items involving contact with human food. There are, however, many plastic formulas for uses in products where toxicity is not of particular significance and consequently, one or more of these stabilizers can be safely used. Obviously, when these heavy metals are used, adequate, safe handling procedures must be utilized in the manufacturing plant. These involve the practice of good industrial medical and hygiene procedures.

Lehman has also stated that zinc oxide, zinc stearate and salts of manganese and copper are not objectionable as stabilizers in food wrapping material if not more than 50 ppm. of the metal leaches out into the food.

Some of the newer stabilizers for vinyl resins are the organic tin compounds. Elemental tin has been used for many years as a lining for food containers and is relatively harmless. The organic tin salts, however, while not known to be harmful have not thus far been shown to be sufficiently safe for use in food container applications. The plant manufacturing operations involving the use of the organic tin stabilizers may present some industrial health problems but again the degree or extent of these is not known at the present time.

SOLVENTS

In the processing of plastics into products, a number of chemicals are used. These include aromatic hydrocarbons, chlorinated hydrocarbons, petroleum distillates ketones, acetates and alcohols. These compounds are all toxic in varying degrees and present certain medical problems in their handling. Specific methods for determining the atmospheric concentrations of these chemicals can be found in Jacob's text.

The American Conference of Governmental Hygienists suggested the maximum allowable concentrations of many of the more common solvents in Table II.

The aromatic hydrocarbons are used extensively in the processing of plastics. Of these, benzene (benzol C_6H_6); toluene (toluol $C_6H_5CH_3$); and xylene (xylol, $C_6H_4(CH_3)_2$) are the principal ones. These compounds are of value because of the fact that they are excellent solvents.

TABLE—II

Suggested Maximum Allowable Concentrations
(Parts per million parts of air)

Acetone	1000
Acrylonitrile	20
Amyl acetate	200
Amyl (iso) alcohol	100
Benezene (benzol)	35
Butadiene 1, 3	1000
Butyl acetate	200
Butyl alcohol	100
Carbon tetrachloride	25
Ethyl acetate	400
Ethyl alcohol	1000
Ethylene dichloride	100
Gasoline	500
Heptane	500
Hexane	500
Propyl acetate	200
Propyl (iso) alcohol	400
Methyl alcohol	200
Naphtha (petroleum)	500
Perchlorethylene (tetrachlorethylene)	200
Stoddard solvent	500

TABLE—II

Suggested Maximum Allowable Concentration (Parts per million parts of air)	
Tetrachlorethane	5
Tetrachlorethylene	200
Toluene	200
Trichlorethylene	200
Xylene	200

As pointed out by Wilson benzol poisoning may result from absorption of benzene by either the respiratory tract, the alimentary tract, or probably the skin. Cases of poisoning in human beings have been found with exposures to atmospheric conditions as low as 25 ppm. Concentrations of 50 to 100 ppm. are considered to be safe for the average person. Individual susceptibility varies. Acute benzol poisoning is rare.

As pointed out by Wilson the pathologic manifestations of exposure to toluene are a matter of controversy. The conclusions reached by various authors are in decided variance with one another. Toluene poisoning is

probably caused by absorption through the respiratory system, the skin and the alimentary tract. The absorbed vapours exert a progressive depressant action on the central nervous system and the bone marrow. Toluene is also a pronounced irritant to mucous membranes. A factor to be considered whenever it is employed is individual susceptibility. Exposure to concentrations of toluene from 200 to 500 ppm. for six to eight hours will in most persons cause tiredness and lassitude. Concentrations over 500 ppm. for one to three hours are definitely dangerous and will cause symptoms attributable to depression of the central nervous system and the bone marrow.

Xylene is stated to possess more severe narcotic properties than benzene. Xylene poisoning is relatively uncommon because its volatility is lower than that of benzene or toluene. Chronic poisoning does occur. There is some evidence that xylene exerts an action on the blood forming organs similar to that of benzene. Cases of aplastic anemia have been attributed to xylene vapours. There have been some cases reported in German literature of leukopenia and thrombocytopenia with no reduction in red cells.

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The commonly used chlorinated hydrocarbons in the plastic industry are :

- Carbon tetrachloride (tetrachlormethane) CCl₄
- Ethylene dichloride (dichlorethane) C₂ H₄ Cl₂
- Tetrachlorethane (acetylene tetrachloride) C₂ H₂ Cl₄
- Trichlorethylene (ethylene trichloride) C₂ H Cl₃
- Perchlorethylene (tetrachlorethylene) C₂ Cl₄

The most toxic of the group is tetrachlorethane, having, according to Matruchot, a comparative toxicity of 6.0. Carbon tetrachloride is listed by the same author as having a comparative toxicity of 2.6, trichlorethylene of 1.0, perchlorethylene of 1.4, and ethylene dichloride of 1.6. According to Davis and the U. S. Public Health Service, the maximum allowable concentration of carbon tetrachloride is 100 parts per million. According to Elkins this level is too high and should be reduced to 50 parts per million.

Many of the petroleum distillates are used. Gasoline (unleaded) hexane, heptane, Stoddard solvent, varsol, and naphtha are mixures of hydrocarbons, paraffins, olefins, cycloparaffins (naphthenes) aromatics and other impurities including sulphur. Cracked gasoline may also carry a fairly high percentage of benzol (benzene). These distillates are narcotics and it is possible to produce complete anesthesia with heavy doses. However, their anesthetic properties are much less than those of the aromatic and chlorinated hydrocarbons. For this reason they may be more desirable for commercial use. Drinker and associates, in studying the effects of gasoline vapours found that concentrations from 270 to 500 ppm. were tolerable. Nuromuscular symptoms began at about 900 ppm. mild intoxication at 2,000 ppm.

Acetone, methyl ethyl ketone, methyl isobutyl keytone and methyl amyl keytone are also used. In our experience no cases of occupational disease have been attributed to the ketones.

Methyl, ethyl, propyl, isopropyl, butyl and isoamyl acetate may be used. These solvents are considered severely toxic and in most cases the allowable concentrations are based more on comfort than on toxic requirements.

Methyl, ethyl, isopropyl, amyl and butyl alcohol are all used at times in plastics manufacture. Methyl alcohol is a source of grave injury to many industrial workers.

It has a specific action on the optic nerve, and with long enough exposure, blindness may result. The action

is that of atrophy. A considerable amount of methyl alcohol poisoning was noted during prohibition days with subsequent optic nerve degeneration and blindness. The other alcohols, because of their volatility are not considered to be especially dangerous. Cases of narcotic poisoning have been attributed to them but not proved. The higher alcohols, like butyl and amyl, have in addition an irritant action as well as some poisonous action on the protoplasm.

SUMMARY

The advent of a great industry for the manufacture of articles of all kinds made from various chemical compounds has created many new problems for the industrial physician and the industrial hygienist. Many of the compounds used are new and very little, if anything is known about their toxicity. Also, since there are no set formulas or receipes, each plastic article may have a different composition.

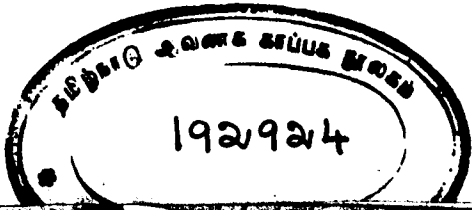
This paper attempts to discuss the toxicity of the more common compounds now being used in plastics manufacture. Resins, plasticizers, stabilizers and solvents are discussed in some detail in regard to their toxic properties. The scarcity of knowledge of the properties of many of the chemicals is sufficient reason for further study.

It is not enough for industry to make better things cheaper; it must also make them safely.

RESUME

Articles made of a variety of chemical combinations commonly called plastics have found increasing favour with the consuming public. Many useful products can be made stronger, better looking, longer wearing and at lower costs employing these versatile new materials. The imaginative creativeness of the human mind is evident in our new world of plastics. To create these man-made marvels, the research chemists and development engineers have not only used known chemicals but also have created new ones.

Unfortunately, many of the chemicals currently used are known to be highly toxic. Even worse, the toxicity of many of the newer chemicals is not even known. Thus, industrial medicine and hygiene face serious problems both from known and potential toxic hazards. Considerable information has been published concerning some of the chemicals now being used in plastic manufacture, and at the present time many chemicals are undergoing toxicological investigation.



The authors of this paper have accumulated information on many of the resins, plasticizers, stabilizers and solvents being used in the manufacture of numerous plastic articles. It will be noted that the information is meagre in some instances while in others it is quite complete, but, to our knowledge, this comprehensive summary on the toxicology of plastics has not heretofore been attempted.

Among authors' conclusions is that industry must maintain strong Departments of Industrial Medicine and Hygiene to control toxicological hazards. Many industries are diversifying manufacturing activities and entering fields of endeavour for which previous experiences may not have prepared them. Highly toxic chemicals cannot be successfully handled in a haphazard manner and it is essential to invest money for toxicological investigation, because to be without such programmes is foolhardy and more expensive in the long

run. No industry can afford to endanger the health of its people by knowingly exposing them to toxic materials.

It is not enough for research chemists to discover a chemical combination, which will create a new sales masterpiece. The industrial hygienist must also determine the toxicity of the chemicals involved and designate ways and means of handling them safely. If the sales potential of a new plastic does not warrant toxicological study, then the product should not be produced.

Another conclusion of the authors is that much additional toxicological study is necessary on plastics, and it is hoped that the toxicology of plastics can be added to and made more complete, year after year.

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A Plastic Surgeon was consulted by a chap with an enormous nose.

"Yes, I can help you", said the Plastic Surgeon, "at a cost to you of one thousand dollars".

"One grand to shape up a nose? Can't you suggest something else, Doctor?"

"Yes" replied the Plastic Surgeon "I could perform a less extensive operation for five hundred".

"Still too high, Doctor, any other suggestions?"

"Yes" answered the Plastic Surgeon, "Why not close your eyes and run smack into a tree".

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WANDERING TEETH

BY DR. B. SUBBARAMIAH, B.SC., M.B.B.S.

District Medical Officer, Mandya. (Mysore State)

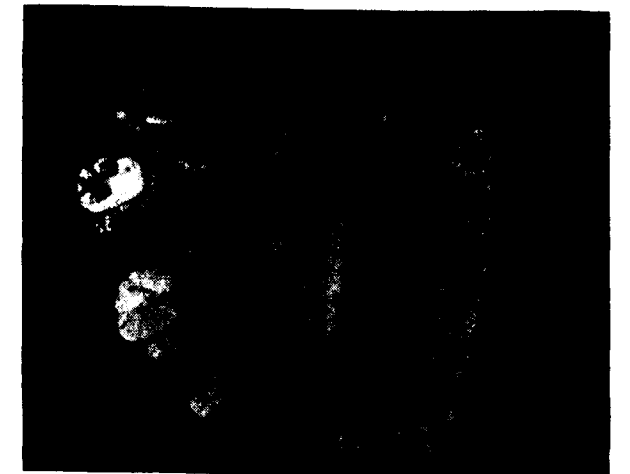
I must say a few words of explanation about the title of the paper which probably has caught your attraction like the Headlines in a News Paper. The term "wandering" is not similar to the one used in case of a spleen or kidney where an organ has undue mobility and is placeable in positions far removed from its normal anatomical position. It is used to mean, that in the cases seen by me, teeth were found in most surprisingly unusual and unexpected positions in different persons.

It is common to find the lower third molars with many malpositions but even here it is found in its expected position with its axis varying very widely. It is also known that the wisdom teeth usually erupt between 18 to 40 years of age, or, not at all, though uncorrelated with the wisdom of a person.

CASE I

The first case was seen by accident in 1931 in a specimen of the base of the skull preserved in the Department of

Anatomy, Medical College, Mysore. Here I found two teeth directed antero-posteriorly and placed one on either side of the middle line in the middle of the hard palate



Case 1.

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LITERATURE
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as you see it in the photograph 1. The study of the upper dental arch showed that the condition was in an adult over 18 years of age with all the permanent teeth normally erupted. The crowns of the teeth in the hard palate were irregular and the teeth were only slightly stumpy. The position of the teeth is inverted with the roots at the buccal arch and the crowns towards the throat. The bone covering the roots showed mild destruction and the left tooth was almost dropping off.

CASE II

The second case was seen in a boy of seventeen years of age who came to me at Tumkur with a complaint of having some foreign body in his right nostril, and noticed by him and his attendants for over 2 years. On examination I found a dirty, creamy white, globular, ivory hard mass less than $\frac{1}{2}$ an inch in diameter embedded firmly in the mesial part of the floor of the right nostril. On probing I could go round the mass and could not move it. On examination of the mouth the upper central incisor teeth was missing. I took a photograph, photograph 2 which is presented here and I formed a tentative diagnosis that the mass in the nostril



Case II.

may be a foreign body firmly embedded on account of long standing implantation or an ivory exostosis in a very unusual position. I was surprised that the mass was extractable just like a tooth when I tried to extract it with a bone nibbler. My surprise was greater when I found the extracted mass to be a stub like rounded teeth with an irregular crown pointed towards the nose and a

very short root embedded in the maxilla forming the floor of the nostril. It was the central upper incisor which was missing in the arch in its usual position but it did not resemble and incisor tooth at all in shape.

DISCUSSION

In dental work X-Rays must be constantly used to ascertain the cause of delay in unerupted teeth and the cause for any irregularity.

There are certain parts of the jaws which are more commonly the site of unerupted teeth or supernumerary teeth.

The upper incisor region is the commonest site of unerupted supernumerary teeth (vide case 2) which may or may not be causing delayed eruption of the permanent tooth or displacement of erupted ones. Supernumerary teeth may be single or multiple and are occasionally encountered in an inverted position. When single they are usually found in the middle line of the maxilla (vide case 2) but when multiple they occur on each side of the middle line (vide case 1) and usually behind the permanent teeth. Supernumerary teeth usually have an irregular crown (vide cases 1 and 2). The upper lateral incisors are frequently absent. The upper canine is very seldom absent. In case 1, probably the infantile high position and out of the way position is maintained and eruption has not occurred. The canine is very frequently displaced slightly or grossly and may tilt or rotate the lateral incisor. The canines may be situated obliquely, horizontally or even across the dental arch. They may be in close contact with the antra or nasal cavities.

It is much less common to find supernumerary teeth, abnormality in position or absence of teeth in the mandible. These conditions may be met with in the



Case III.

incisors, less with canines, more often with premolars and very often with the third molars.

CASE III

In a third case of an adult male aged twenty four years, I found the patient complaining of a progressively increasing swelling in the region of the right mental protuberance. The swelling was of the size of a sparrow's egg. His complaint was that he had a 'chronic abscess' in that region which had burst and was showing slight discharge without any tendency to heal over a period of three years. A small sinus which could admit an ordinary probe tip was present on the lower right side of the swelling with slight heaped granulations at the opening. On probing a metallic click was heard and grating was felt. A radiogram showed the condition to be a Dentigerous Cyst with a tooth in it almost on the

point of being shed. The tooth was removed and the cyst cavity scraped and the wound healed easily.

DISCUSSION

(Dentigerous Cysts occur in the Mandible and less frequently in the Maxilla). The Cysts always contain the whole or some part of an unerupted tooth. The area of bone around the tooth shows no structure, the margin is clearly defined but not corticated as in a Dental Cyst. Often infection of the follicle of the permanent tooth occurs through the agency of an infected deciduous predecessor and results (1) in acute infection, death and sequestration of tooth as in this case, (2) in subacute infection without damage to the permanent tooth, or (3) in progressive destruction of bone and formation of a dentigerous cyst cavity.

"You'll have to cut alcohol", ordered the doctor. "And no tobacco either. That also goes for women. You've got to be in bed by nine p.m. every night. That's the best advice I can give you".

The old rogue looked crestfallen "Look Doctor", he pleaded, "the kind of life I've led I don't deserve the best. What else would you suggest?"

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INJECTABLES	Each c. c. Contains: Folic Acid 5 mg. (Na-Salt) Vitamin B ₁₂ 30 mcg.		Boxes of 6, 12 & 50 Amps. of 1 c. c. each & 10 c. c., R. C. Vial.

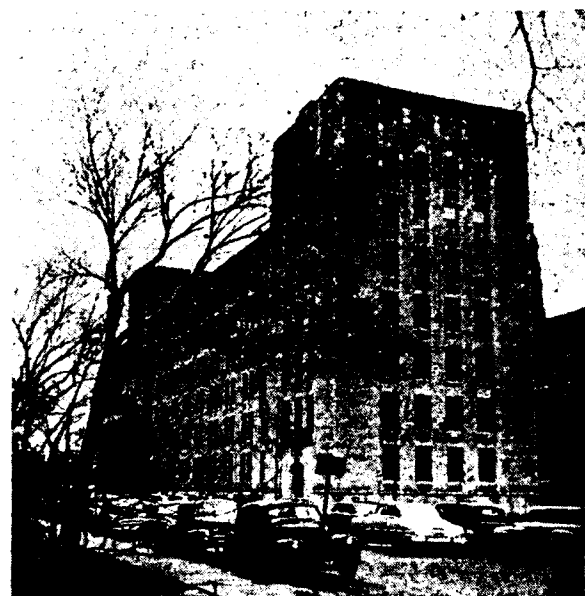
Literature from

Argonne Hospital is World's Largest Cancer Research Centre

(From a special Correspondent)

IN Chicago, Illinois, in a hospital specially designed for the purpose by the U. S. Atomic Energy Commission, a large staff of doctors and medical researchers is working day and night to determine the ability of the atom to treat and possibly cure cancer.

The hospital is the Argonne Cancer Research Hospital, the largest hospital in the world devoted exclusively to



The Argonne Cancer Research Hospital in Chicago, Illinois, is the largest hospital in the world devoted exclusively to research on the cause and cure of cancer.

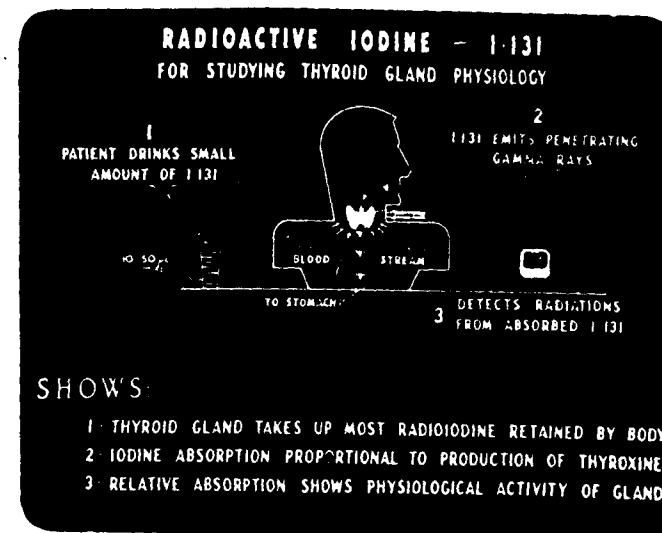
research on the cause and cure of cancer. It is one of four clinical facilities for cancer research which the Atomic Energy Commission has constructed in accordance with the United States' national atomic policy. This is to use the atom "to improve the general welfare and increase the standard of living".

The Argonne Hospital was opened in 1953, and is one of the units of the University of Chicago Cancer Research Centre. Its main function is to learn how atomic radiation can help to control cancer. Accordingly, it is devoted only secondarily to the actual treatment of patients. Only two of the building's eight floor are for the care of patients. The others are for fundamental research.

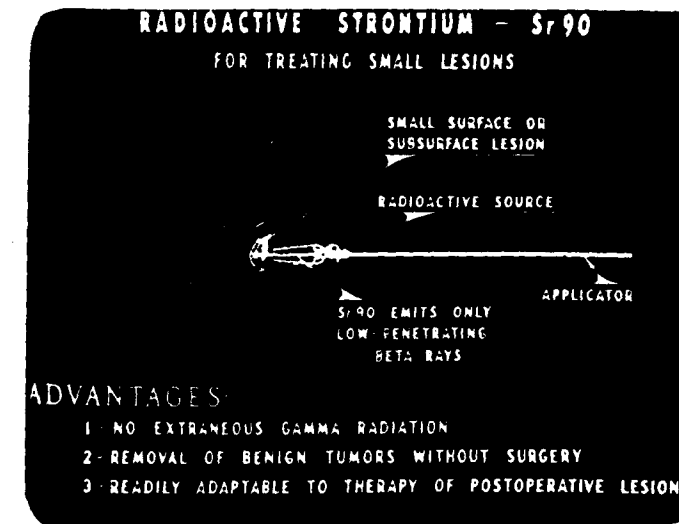
Radioactive isotopes—one of the most important peaceful products of atomic energy—are one of the principal medical tools that the hospital is studying and using. These are ordinary chemical elements such as



At Argonne Cancer Research Hospital on the campus of the University of Chicago, the world's first hospital designed specifically for atomic-age treatment, doctors studying allergy inject radioactive ragweed into a guinea pig. Investigators watch high-energy radiation operations through three-foot thick windows containing a solution of zinc bromide which screens out the harmful rays.



This self-explanatory print was produced from a slide designed to demonstrate one of the uses of radioactive iodine.



This self-explanatory print was produced from slides designed to demonstrate one of the medical uses for radioisotopes.



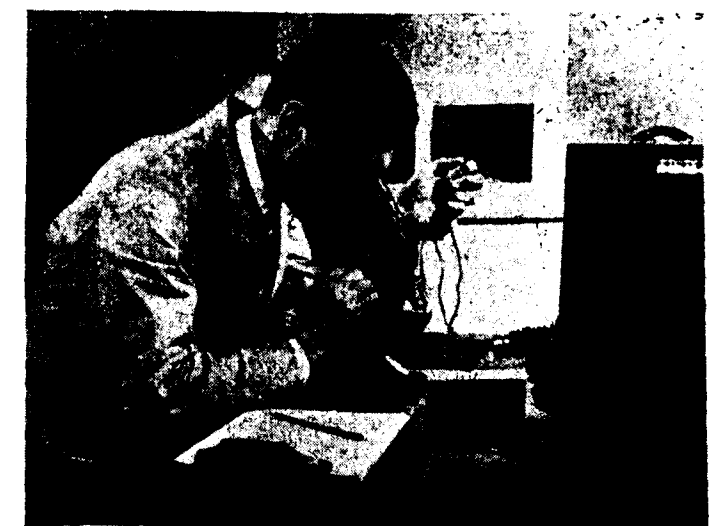
Atomic research at Argonne National Laboratory in the United States has proved that dextran, a starch-like vegetable product, is an effective substitute for blood plasma. Millions of persons throughout the world may be benefitted by this achievement, which enables physicians to carry with them a blood expander in treatment of shock in cases of emergency or when blood plasma is not available.

The first step obtaining radioactive dextran to be tested as a blood plasma substitute was to grow a crop of common canna plants in a greenhouse at Argonne National Laboratory near Chicago, Illinois.



At Argonne Cancer Research Centre, a radioisotope in a two-foot lead container is placed in the radioactive atom bank.

This bank is composed of 40 stainless steel tubes encased in solid concrete extending eight feet below the basement floor. The building is equipped with a wide range of high-energy radiation machines and thus all possible safety precautions are incorporated in its construction.



Dr. Harvey M. Patt studies the blood cell count of an irradiated rat at the Argonne National Laboratory in Chicago, Illinois.

iodine, cobalt or gold, which have been made radioactive in an atomic reactor. They emit radiations which can be detected wherever they are, and thus their movements within the human body can be closely followed and studied. When used in this way, radioisotopes are often called "tracer atoms".

Other radioisotopes are used as a source of radiation, to treat cancer in the same way that it is treated with the radiations of X-rays.

At the Argonne Hospital nearly 300 different radioisotopes are currently being evaluated and tested. These radioisotopes are furnished to the hospital by the U. S. Atomic Energy Commission.

One of the new devices that is being thoroughly tested is the Cobalt 60 radiation unit—an instrument for using the radiations emitted by radioactive cobalt, which is a radioisotope. This unit emits rays 1,800 times more powerful than one gram of radium and has the curative effect of a 2,000,000-volt X-ray machine. The instrument is mounted so that it can be rotated around the patient in order to direct the radiation only at affected areas of the body.

Radioiodine—another radioisotope—is also being studied and tested. It is the atomic medicine which, to date, has helped the largest number of people. It has brought back to health and tranquility hundreds of patients who have suffered with an overactive thyroid—hyperthyroidism or toxic goiter. It also has checked thyroid cancer in some cases, and has been successful in reducing the number of attacks of angina pectoris in persons suffering from that type of heart disease.

Important as the present diagnostic and therapeutic uses of the radioactive atoms are, it is probable that even better ways of treating diseases may eventually result from the basic research now going forward. The radioisotopes have opened the doors to scores of research problems which previously were considered too difficult to solve with conventional instruments.

It is now possible, for example, to put one or more radioactive atoms, or radioisotopes, into large and complex molecules which play important parts in the body mechanisms, and thus to follow their travels in the hope of learning why these mechanisms occasionally go wrong. Cancer-producing chemicals are being watched this way as they pass through the bodies of animals. Other research is trying to discover why body cells lose calcium as they become cancerous.

(Photos: Courtesy of USIS—Bombay)

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Chlorpromazine and Intractable Hiccup

(A Case Report)

By DR. S. RAMANATHAN, L.M.P.
Vadugapalayam, Palladam (South India)

ON 27—2—'55 I was called to attend upon a patient said to be suffering from obstinate and continuous hiccup for 9 days.

A BRIEF HISTORY

The patient, a man of 55 years, with wife and several children alive and healthy, was an agriculturist by profession. No history of any previous disease was available, but during the preceeding 3 months, had on 2 or 3 occasions experienced slight difficulty in swallowing solids but not liquids.

On 18—2—'55 he developed hiccup. The onset was sudden with no dysphagia preceeding. This hiccup, mild at the beginning became alarming and troublesome as it continued without interruption the whole day and the succeeding night. Medicines whatever suggested and offered (of all systems including allopathic) were tried in

his mental and physical condition. The patient practically starved and had no sleep.

Hence by 27—2—'55 when I saw him, one week has elapsed. By then, the hiccup had become continuous, the patient was much exhausted, bore an anxious expression, was sweating profusely and had all the symptoms of starvation. The hiccup was continuous, intractable and became unmanageable. His B. P. was 110/78 M. M. Hg. and his pulse 90.

A series of conditions had to be thought of, such as, oesophageal neoplasm, cicatritial and spasmodic contraction, cancer and ulcer of the oesophagus, thoracic aneurysm, mediastinal growth, thyroid cancer, carcinoma of the larynx and obstruction, pleurisy, pneumothorax, bronchitis, broncho pneumonia, pericarditis, and affections of the diaphragm, including paralysis and contractions.

But the immediate concern was, how best to bring about an improvement in the intractable and unmanageable condition of hiccup which had exhausted the patient considerably. He failed to respond to nearly all the common and usually available remedies that could be tried for the conditions. Of course it was possible to induce sleep by the administration of barbituates and Morphia, but the pity was, the hiccups continued even during sleep.

The only drug that could be thought of and tried under the circumstance and as a last resource was CHLORPROMAZINE.

The difficulty was that the drug was not available from any where near by. It had to be got from Madras and hence it was possible to administer the medicine only on 3—3—'55. CHLORPROMAZINE HYDROCHLORIDE, 'LARGACTIL brand' was the preparation used.

An intramuscular injection of 50 Mg. was given at 12-30 P. M. on 3-3-'55, which had the effect of stopping the hiccup in 30 minutes. The patient was seen again at 6-30 P. M. For 6 hours—this was the longest interval when freedom from hiccup was experienced during the past 12 days.



— Intractable hiccup —
The Patient is seen here seated.

vain and the patient appeared all the more worried and anxious. No pain over chest or abdomen, no abdominal discomfort or vomiting were complained by the patient. But a perceptible change for the worse was noticeable in

The patient appeared cheerful, hopeful and much encouraged but expressed his fear that he may again develop the trouble during the course of the night. Hence the injection was repeated at 7 P. M. The patient was again seen at 3-30 P. M. the next day. During this period of Twenty and half hours, he is reported to have thrice developed the trouble, namely at 9 P. M. at 2 A. M. and at 12 noon on 14-3-'55. The two attacks, at 9 P. M. and 2 A. M. were only witnessed by his attendants, but not actually felt by the patient as he enjoyed sound sleep during the night.

The injection was repeated at 3-30 P. M. on 4-3-'55. His B. P. was recorded and found to be 90/60 M. M. Hg. Hence, it was clear that the two injections given the previous day did produce an appreciable fall in B. P. The only symptom, complained by the patient, was, that he lacked courage and confidence to stand up or walk without help. The patient was advised to adopt the horizontal and head-down positions in view of the hypotension observed. Thereafter, the tendency became less marked as the treatment was continued and after the 4th injection on the third day the B. P. reached the original level. Night mares were reported at the beginning.

After the 4th injection (on the third day) no further hiccup was reported and remarkable improvement was noticed in his mental and physical condition. Dietetic restrictions were few through out but after the subsidence of the hiccup his usual diet was allowed and he was able to follow his usual routine of work.

HICCUP is described as a sudden spasmodic contraction of the diaphragm. Mostly it is temporary, but sometimes it becomes obstinate and intractable, and developing as a complication in acute abdominal disease it makes the prognosis bad.

Different types are described such as inflammatory, infective, specific and neurotic etc. Treatment of the

condition sometimes is very simple and other times extremely difficult. Sometimes, spasms are abolished by merely holding the breath as long as possible. The drinking of a little water, or a dose of Carminative mixture with Oil of Peppermint and aromatic Spirit of Ammonia added to it effects a megal cure. Antipyritics, application of poultice, cold applications, lavage of the stomach, and the induction of vomiting have produced good results. Chloroform, Nitroglycerin and Amylnitrate are also tried. Purgatives, the administration of Chloral Hydras and Bromide, counter irritation of the epigastrium or the root of the neck are also methods adopted.

I remember an accasion, when, several medical men, including myself, failed to give any relief, until small-pox eruptions became manifest with natural improvement and in which case, during the pyrexial period digestive symptoms predominated. I am mentioning only a single instance out of many discouraging and encouraging results.

I am sure, many of my friends would have tried CHLORPROMAZINE, which upto now was largely used as a sedative, to lower body temperature, to quiet metal patients, and to relieve severe nausea and vomiting. To such of those who are not much used to it, I suggest, that the same may be worthy of a trial in unmanageable, obstinate, and intractable cases of HICCUP. Perhaps, the HICCUPS are stopped *almost immediately*.

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Two pilgrims started for the Holy Land and as a matter of deep penance they agreed to place peas in their Shoes.

Reaching Jerusalem, one of the pilgrims rested his aching feet. Every bone and ligament seemed on fire from the rolling movement of the peas. But the other pilgrim showed no distress whatever.

"How come", asked Pilgrim one; "that your feet show no discomfort?"

"Because" answered Pilgrim Two, "I boiled my peas before we started".

Ace Scientist Dead — Sir A. Fleming — Discoverer of Penicillin

BY A SPECIAL CORRESPONDENT

SIR Alexander Fleming, who lengthened the life of mankind by discovering penicillin, died in London on 11th March, 1955 of a heart attack. He was 73.

He was struck down suddenly by a seizure. Not feeling well at his home on the morning, he called for a thermometer, took his own temperature, drank a glass of water and then lay down. He died half an hour later.

Thus passed a man long likened to Madame Curie and Louis Pasteur as a benefactor of man in the struggle to live.

He died peacefully and did not seem to be in any pain, at the modest Danvers Street home of the Scientist in Chelsea. It was a tremendous shock to all his admirers and friends particularly when he was quite well up to the morning of the day he died. He had breakfast in bed, read the newspapers and was opening the post when he felt unwell. After drinking a glass of water he lay down and within half an hour was dead.

Lord Horder, 84, one of the most eminent doctors in Britain and Physician for years to the Royal family, said of Sir Alexander's death:

"Sir Alexander Fleming will go down in history as the greatest name in British medicine since Lister. His discovery of penicillin was the result of infinite patience linked with a genius for research. Through it Sir Alexander conferred a benefit upon humanity that is quite incalculable.

Twenty-five years ago, Sir Alexander discovered penicillin by one of the most momentous accidents in history. As he was conducting bacteriological research in his library, a fleck of vegetable mould was wafted into the room by the wind and alighted on one of the saucers in which he was tending germ cultures.

Sir Alexander took a look at the speck through a microscope. The germs in the saucer were dying.

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Sir Alexander followed up his discovery with experiments. It was more than a decade later that the antibiotic penicillin was refined and given to the world to begin its merciful work as a mass healer.

It was characteristic of the quiet and retiring scientist that he did not profit commercially out of his discovery. He claimed no money from the manufacture of the life-saving gift he gave no humanity.



Sir Alexander Fleming discoverer of Penicillin, pictured recently on the eve of his departure for Athens where he attended the Council of the Organisation of International Medical Scientists at the Congress of the World Medical Association in Athens as a delegate.

Sir Alexander was given the Nobel Prize for medicine jointly with Sir Howard Florey and Dr. E. B. Chain in 1945.

At St. Mary's Hospital, in the Paddington district of London, is a doorway crowned with the inscription: Wright-Fleming Institute of Microbiology, commemorating two of the world's greatest bacteriologists and a notable era in British medicine. Almroth Wright discovered how to prevent typhoid by inoculation, and Alexander Fleming discovered penicillin.

APRIL 1955

Wright, Fleming's master, is dead; Fleming, now 73, has announced his coming retirement from the directorship of the Wright-Fleming Institute.

Son of an Ayrshire (Scotland) farmer, Fleming went to London at the age of 14, completed his schooling and began work at a shipping office. Aided by a small legacy, he entered St. Mary's Hospital in 1901, and after an exceptional career as a student joined Wright's team of researchers soon after he qualified in 1906. Wright's laboratory at St. Mary's was then attracting doctors from all over the world, and his startling medical theories gave Shaw his idea for *The Doctor's Dilemma*.

During World War I, Fleming went to France with Wright's team and devoted himself to the study of septic wounds, which were causing terrible losses. His experiments, now "classics of the laboratory", made him a militant disbeliever in the efficacy of chemical antiseptics. Yet—nice irony—he was to deliver to the world the most perfect antiseptic of all.

ANTI-BACTERIAL AGENT

For his great discovery he was prepared in a very curious way. He had a cold and, to satisfy his inquisitive disposition, cultured some of his nasal secretion. To his amazement he noticed it contained a substance which prevented bacterial growth. This substance he traced to his tears. Where they dropped on his culture-plate, clear spaces remained. He called his newly-found anti-bacterial agent lysozyme.

Six years later, in 1928, he saw clear spaces on a culture-plate where a fleck of mould had landed amid a germ colony he was growing. Mouldy culture-plates are commonplaces of the laboratory but Fleming, reticent, dour and acutely perceptive, recognized it for the event it was. "Instead of casting out the contaminated culture with appropriate language", he has remarked, "I made some investigations". And again: "I am glad that for years my interest had been directed to antiseptics and that some years before I had found another naturally occurring antiseptic, lysozyme". Moreover, he had devised methods for the study of lysozyme which proved invaluable when he found penicillin.

Despite persistent efforts, however, he could not find the way of bringing penicillin into general use as an antiseptic; it was too elusive and too unstable. "I was a lone individual," he has explained, "more or less alone. I collected a couple of juniors in a laboratory afterwards, and we did a little bit of work and got as far as we could. We found out a lot of things about penicillin and then got struck—short of chemical knowledge".

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Meanwhile, Professor Harol Raistrick, of the London School of Hygiene and Tropical Medicine, having read Fleming's paper about penicillin in a scientific journal, decided to investigate the substance. He was as baffled as Fleming had been by its erratic behaviour, and could make only limited progress. Fleming himself used it on a few hospital cases with unspectacular, if favourable enough, results, and he used it consistently for certain technical procedures in his laboratory.

Its resuscitation came in 1938, when Professor Howard Florey and Dr. E. B. Chain at the Sir William Dunn School of Pathology, Oxford decided to make a systematic enquiry into the subject of organisms which produced substances affecting the growth of other organisms. Passing under a great elm at the entrance to the park on their way home one evening, they decided to begin working on penicillin.

"A MIRACLE"

By 1940, when German armies were forcing their way to the Channel coast of France, they were ready for a crucial test, at the same time resolved to escape with the mould smeared on the linings of their jackets and

around their inner pockets should German soldiers ever set foot in Britain.

Florey injected 50 mice with a huge dose of virulent germs. Twenty-five were left untreated, 25 were given penicillin. Within 16 hours the controls were dead, while the penicillin-treated mice, with one exception, had survived. Report has it that Florey picked up a telephone and speaking to one of his team said: "It looks like a miracle".

Perhaps it was; it came in time to save the wounded of World War II from the horrors of sepsis, which had caused much mortality in World War I, and which had so much occupied Fleming's thoughts.

Today, 25 years after its discovery, penicillin is a household word and numberless people in every corner of the earth have experienced its life-saving powers.

For their achievement Fleming, Florey and Chain shared Nobel Prize. What Fleming had begun at St. Mary's in London had triumphantly been concluded at Oxford by Florey, an Australian, and by Chain, a European Jew who had found safety in Britain. They had been assisted by a brilliant group of researchers who had come to be known as "the Oxford team".

Industrial Heat-Load Problems in India

By DR. WILLIAM F. ASHE, M.D.

(Specially Contributed)

THE author recently visited India as a consultant in thermal environmental health problems to the Central Government of India.

India is a hot country. Each year most areas experience extremes of hot dry weather in the early spring and summer. Temperatures of 110°F and better are not uncommon. In the late summer many areas experience the monsoon and have temperatures in the nineties with humidities often approximately 100%. As most of you know the chief limiting factor to work in hot environments (after proper acclimatization, proper fluid, and salt balance) is the wet-bulb temperatures. As long as there is a reasonable differential between body temperature and the wet-bulb temperature to allow for evaporative cooling, heavy work can be done without serious danger to health up to at least 120°F. Comfort is, of course, another matter—to be discussed later.

India is industrializing rapidly. When one adds hot mills to an already hot country he promptly runs into trouble with thermal environmental conditions affecting workers.

Textiles (cotton and jute principally) constitute the largest single industry in India at present. Artificial humidification of the work rooms, especially for spinning of fibres on the machines. Frequently this is done with live steam, and commonly with cold water and an atomizer-fan gadget. After weeks of this procedure, plus hot weather in stone or concrete buildings, the wet-bulb temperatures of working areas get up to levels incompatible with long continued survival to say nothing of optimum productivity. For the most part labour tries to solve its own problems by going out for a "breather" at very frequent intervals, but heat casualties and occasional deaths do occur. Manufacturers probably cannot afford industry-wide air conditioning in the already established mills (over 250 of them employing from 1000 to 8000 men each). Health safety codes, applicable to the U. K. or U. S. A. don't fit in India because the climatic conditions themselves often exceed our maximal allowable in-plant temperatures.

Steel mills and foundries with their high radiant heat loads plus high ambient temperatures, present another serious problem, and heat casualties are admittedly quite common.

The problem around the driers and calendar stacks of paper mills presents both the textile type of problem and the steel-mill type. Aluminum plant pot rooms, rubber and glass factories, etc., present interesting variations of the same type of problem.

Indian authorities in the Ministries of Labour and Health are much concerned and want to do something about it. One cannot be certain that the upper safe limits of heat loads which apply to healthy acclimatized American soldiers doing hard work under controlled conditions also apply to Indian labourers. On the one hand one might expect better heat tolerance by virtue of generations of acclimatization. On the other hand lower tolerance is possible because of malnutrition, intercurrent disease, and the ultimate fatigue which comes when stress is carried too long.

It is obvious then, that certain basic studies must be repeated in relation to Indian workers. In addition to his tolerance to heat his water drinking habits must be known, his mineral metabolism and his productivity in relation to effective temperatures which are safe but uncomfortable. (Note. There are 1000 available job seekers each morning for every available job).

Working with Indian authorities, a series of studies have been planned which will define these problems accurately. Edward J. Largent, Research Associate of the Kettering Laboratory of Applied Physiology of the University of Cincinnati, will spend two years in India supervising these studies.

Climatic maps of India for the months of April through October are being made. Superimposed on them is an industrial map of India. From the two, sites will be selected to collect in-plant thermal data in all types of industry. Temperature, humidity, air movement and radiation (where indicated) will be measured throughout two hot seasons. Seasonal accident rate and absentee data are being collected. In some plants it will be possible to get accurate production figures for comparable machines by seasons.

At the Ahmedabad Textile Industries Research Association Laboratories a psychrometric chamber is

(Continued on page 39)

PRESBYOPIA AND POVERTY

By DR. D. SHAMANNA, B.A., M.B.B.S.

Chitaldurg, Mysore State

PRESBYOPIA or old sight is a physiological change which affects every eye at about the 45th year, as a result of which the near point recedes beyond the distance at which we are accustomed to read ordinary print. The change is due to loss of elasticity of the lens whereby it is prevented from responding to the action of the ciliary muscle. So the power of accommodation is diminished, when the diminution in the power of accommodation becomes sufficient to interfere with the comfortable exercise of near vision Presbyopia is said to be present.

About the age of 45 most people except myopes experience difficulty regarding near vision. Vision becomes slightly blurred there is a tendency to hold reading, writing sewing and other forms of near work farther away from the usual distance making such efforts uncomfortable. With the recession of the near point beyond the situation the print becomes indistinct and fine type can be read only with difficulty. Subjects are apt to use strong illumination. If the condition is uncorrected they suffer from asthenopic symptoms especially headache fatigue, lacrymation etc., all these being more marked in the evening. Presbyopia has no effect upon distant vision.

The treatment for Presbyopia consists in wearing convex spherical lenses for near work to compensate for the lack of power of accommodation and to bring the near point back to a comfortable distance.

The above text-book information of Presbyopia is recalled to refresh our minds of this condition.

In our country too as elsewhere there must be a great number of people engaged in professions which involve near work such as clerks, teachers, carpenters, goldsmiths, musicians, tailors, etc. The near distance at which the people have to hold the objects may vary from profession to profession. The very existence of some depends on the ease with which they could carry on the near work. The illiterate general farmer on the land or

his wife entrusted with the ordinary household duties need not have to exert their near vision so much as clerks and tailors.

How many in our country who ought to wear glasses for presbyopia are doing so? How many out of ignorance or poverty, are neglecting this simple remedy and still carrying on their work with difficulty and so with loss of efficiency.

Let us peep into a government office where a number of clerks are employed. Let us survey all those past the age of 45 years having Presbyopia and who ought to take glasses. It becomes apparent that a few will be carrying on their work without glasses, straining their eyes, holding the paper at a distance to bright light, poisoning themselves near doors and windows and closing their work when the light gets dim. These clerks do not do any reading or writing work after sunset. Their work in the office is restricted to a few hours. So far as an individual at the office is concerned, skipping over one's work or postponing it may not appear a serious omission. But collectively what a colossal waste and from the institutional point of view what a loss of efficiency. Those who should read and write and imbibe knowledge and impart it to others, not being able to do so tantamounts to a colossal national waste.

In a factory if there be a group of labourers who are presbyopic and who cannot afford to buy glasses, they contribute indirectly to a diminution in output of the factory though it be to a small extent.

Ignorance and more than ignorance poverty is the factor which prevents people from getting suitable spectacles, for presbyopia. People will have to go an Eye Specialist, get their eyes tested, and buy a pair of glasses the cheapest of which costs about Rs. 10/- per pair. It may be unbelievable, but true that there are clerks and labourers who cannot afford to spend Rs. 10/- on glasses. There is also the question of renewing the spectacles once in 4 or 5 years.

(Continued from page 38)

being set up where heat tolerance, water balance, salt balance, productivity in relation to effective temperature etc., will be studied.

At the All India Institute of Hygiene and Public Health in Calcutta additional physiological studies will be made on work loads in relation to temperature.

not uncommon sight for children to be playing with spectacles as toys. There is no place assigned for the spectacles by some, and everytime the spectacle are required a fervent search is made.

There is also a feeling amongst some of us, that to go about without glasses in old age is sinequon with sound health of the body including the eyes. Such people may be myophes and need no glasses or they may be emmetropes needing presbyopic correction and yet carrying on.

It would be an interesting statistical study to note how many literates and also illiterates in our country who need presbyopic glasses, and glasses for other refractive errors and what percentage of them are going on without correction glasses.

The Shakesperean seventh stage of life does not hold at the present day. The man with sans eyes, sans teeth and sans everything is a varity. Thanks to dentures, hearing aids and spectacles man now can end his strange eventful history with both sense and senses intact provided he takes advantage of the scientific aids.

It is not my desire to strike a note of alarm, but to bring home to the mind of the reader forcibly of a situation in our country, however small its extent be, which is obvious and which with good will and effort all round could be remedied to a great extent.

scientifically trained doctor for presbyopia correction would be to avail onself of a general check-up of the health of our eyes. The aspect is not appreciated by many.

A valuable present for an old man who needs glasses and who cannot afford them is a pair of suitable spectacles. The rich in our country who give handsome donations by way of charity should divert a portion of the donations to opthalmic institutions. By the interest derived from such investment glasses for the direly poor may be bought. This system is in vogue in some places but needs to be intensified.

The above remarks made by me about need of glasses for presbyopia; hold good in a greater measure for other varieties of refractive errors. At least a presbyope can carry on his work without glasses with difficulty but subjects with heavy refractive errors are reduced in their vision considerably and are very much handicapped in life.

An index of our appalling poverty could be had in the spectacle of a few of our brethern carrying on with glasses which have sustained injuries of many kinds and received first aid and other ingenious aid treatment at the hands of the owner.

Some of our people do not exhibit the care needed to look after the glasses for which they have paid. It is

STANDARDIZATION OF GLUCOSE

Two draft Indian Standard Specifications, one for Liquid Glucose and the other for Dextrose Monohydrate, have been recently circulated for comments by the Indian Standards Institution to all interests concerned. These draft standards have been prepared by the ISI's Glucose Sectional Committee.

While formulating the specifications, the Committee has fully kept in view the difficulties which present themselves to the young indigenous glucose industry in the manufacture of these materials, at the same time, the requirements specified in the specifications are such that materials conforming to them would be fairly compatible to the imported stuff. The glucose industry is under the protection of Tariff Commission.

The draft standard for liquid glucose covers three grades of the material, namely low conversion, medium conversion and high conversion. In addition to the various chemical requirements for these materials,

the draft standards also detail methods of sampling and tests. In case of liquid glucose microbiological requirements of an essential character have also been included. Specification for anhydrous dextrose has not been purposely laid down for the simple reason that this product is not manufactured in the country so far.

The Glucose Sectional Committee consists of representatives of the Directorate General of Health Services, Development Wing of the Ministry of Commerce and Industry, Ministry of Food & Agriculture, important manufacturing organizations, such as Messrs. Anil Starch Products, Glucose and Foods Limited, Corn Products Co. (India), Limited; testing institutions, such as Indian Institute, of Sugar Technology, Central Food Technological Research Institute, Italab Limited and consumer interests e. g. Indian Confectionery Manufacturers' Association, Federation of Biscuit Manufacturers of India, The All India Food Preservers' Association.

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Should a pair of lenses and a metal frame to hold them cost as much as Rs. 10/- . Could they not be had cheaper, as to be within the reach of the poorest of our subjects. This is a national question which our governments should tackle. It should be possible to make cheap frames in our own country and in fact this is already attempted in some places. Are the opticians making a huge profit? The prices of spectacles are not standardised in our country and there is a difference in their price from shop to shop. Some of the frames look alike, though of different quality and a buyer of glasses is puzzled if the price he is paying is fair.

Facilities for testing the eyes is also not adequate in our country. Though throughout the country at the District headquarters level there are facilities for refraction work even to come to the District headquarter for getting the eyes tested some find it difficult, and some are too lazy to do it. In some of the rural Eye camps, as much prominence to refraction work as to operative procedures of the eye, is not given, unless an optician is included in the camp, if the glasses, prescribed are not made available at the place where the camp is held, many subjects may not buy them.

Some people when their near vision gets blurred are in the habit of ransacking the trunks and boxes of their dead parents or relatives and pulling out a pair of glasses that was being worn by one of their forbears, and make use of them. Though the vision is improved thereby, scientifically speaking this is a blind method. Perhaps the family heirloom of the spectacle is too strong or too weak for the individual. The correct advice to such individuals should be 'Please get your eyesight tested in an opthalmic institution and get the glasses prescribed by the Doctor'.

The optician quacks who invade villages and attend the weekly fairs held at villages with their ware of ready-made glasses are having a brisk trade. The glasses sold by them is very much cheaper than those available at opticians shops and on account of the price factor many a villager welcomes them. The Quacks do not carry on the orthodox examination of the eyes and the correct glasses needed are not always picked up by the subjects. The tendency is to pick up a pair of lens too strong for the individual and to ignore other defects in the eye. There may be associated defects in the eyes which need remedying which a quack cannot do. Approaching a

MEDICINE IN THE SERVICE OF INDUSTRY

BY DR. VISHNU SARMA, M.A., (Cantab) M.B., B. chir., M.R.C.S. (Eng.) L.R.C.P. (Lond.)

Fellow, Royal Society of Medicine, London

For sometime on the staff of The Medical Research Council, Burns, Scalds & Industrial Injuries Unit, The Accident Hospital, Birmingham, England.

IT is only in the last 25 years that industrial medicine has sprung to the forefront in western countries. It is a relatively new discipline. It cannot be called a speciality because it puts to effective use the contribution which various branches of medicine and allied sciences have made, for the solution of problems peculiar to industry.

Industrialisation is proceeding at a rapid pace in India. It is an important feature of the Five Year Plan. Advance in industrialisation calls for the establishment and development of Industrial medicine. That such a need has already been felt is reflected in the founding, by responsible and well known medical men, of "SURGICAL AND MEDICAL NEWS" — a journal devoted particularly to the interests of those who practice industrial medicine. There is no doubt that such a journal should satisfy clinical curiosity and provide information on the latest advances in the subject. Because the subject is not a speciality it follows that any Industrial Medical Journal should possess wide interests and publish contributions of general interest, not only in medicine and surgery but in related subjects as well.

Foremost among those who advance industry are Engineers, Physicists, Chemists and other scientists. Yet it cannot be doubted that the medical man may make a valuable contribution. In recognition of this many well known and established industries are eager to employ suitably qualified doctors to advise them. What is the role of the physician in industry? His duties may be considered under the following headings:

1. Clinical medicine.
2. Industrial psychology & social relations.
3. Research.
4. Environmental hygiene.
5. The prevention of industrial diseases, accidents & injuries.
6. The rehabilitation of
 - (a) the aged and infirm
 - (b) the disabled.



A Section of the Rehabilitation department, The Accident Hospital, Birmingham, England.

CLINICAL MEDICINE

The greater part of the clinical work of the industrial physician lies in the medical examination of prospective candidates for employment. If such a thing is carried out strictly in the interests of those who are to be employed it is a laudable step. When it is done to avoid financial loss to industry by rejecting candidates with slight deviations from normal health, it is unpleasant because it savours of an inhuman and materialistic attitude which is to be deplored. A complete examination of a prospective employee includes besides a thorough history and general examination, a blood count, a chest X ray, examination of urine and an ophthalmoscopic examination. These are not complicated procedures and most people are willing to submit to them. It is the minimum investigation modern medicine accepts. Those with early manifestations of malnutrition, disease or deformity e. g. postural defects, skin blemishes, dental sepsis, can receive timely advice and necessary treatment. Early pulmonary tuberculosis can be recognised.

The periodic review of workers in industry lends itself to research on what comprises normal health. This is one of the objects of a Community Health centre also.

Chemicals and other noxious materials are employed in industry, and new materials are constantly being introduced. The clinical acuity of the industrial physician may help in the early recognition of the toxic effects of such material as yet unrecognized.

INDUSTRIAL PSYCHOLOGY AND SOCIAL RELATIONS

It is a widely accepted fact that the Personnel Relations Officer plays a key role in industry. It is his interest and concern in the human aspects which make employees feel that they are part of a community, and realize that the welfare of their industry means their welfare too. They do not feel that they are soul-less cogs in a big machine. They begin to take a pride in the quality of their work. Absenteeism becomes less common.

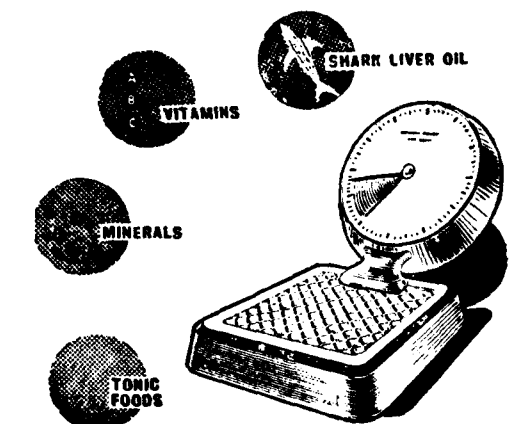
A popular and competent Personnel Relations Officer is a great asset to industry which cannot be evaluated in money. In the encouragement of these human relationships the physician can also render valuable aid. His professional training and knowledge enables him to advise on the psychological factors which lead to discontent among workers. He can also isolate those cases where psychiatric management is required. These may vary in severity from the anxiety neurosis to psychopathies.

RESEARCH

It has become increasingly fashionable to allow the term "occupational medicine" to displace industrial medicine, because it is more encompassing. There are several diseases in the aetiology of which occupation plays a part. The stress diseases (Selye) comprising meladies such as peptic ulceration, hypertension and coronary insufficiency, all appear to be closely related to the vocation of the patient. There is scope for research to determine the extent of this relation in occupational medicine. The newly developed complicated science of statistics helps in estimating the extent of, and the causes of, absenteeism.

ENVIRONMENTAL HYGIENE

To work to the best of his capacity, the worker must have satisfactory surroundings. Fatigue and long hours of work have to be avoided. Machines should be so designed for men so that unnecessary movements are eliminated. Good ventilation, an equitable temperature, and humidity and adequate illumination are all matters



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which can benefit by advice from a competent physician. So too, cleanliness in cooking, storage and serving of food in canteens, methods of cleansing utensils, the provision of washing and toilet facilities all fall within his province. These and other problems comprise environmental hygiene.

THE PREVENTION OF INDUSTRIAL DISEASES, ACCIDENTS AND INJURIES

The prevention of diseases acquired as a result of work (occupational disease) by the use of protective devices and of injury by the strict enforcement of safety laws and the use of protective were are important duties of the factory physician. Of these, injuries including burns and scalds will receive more detailed consideration in the forthcoming articles of this series.

THE REHABILITATION OF

- (a) the aged and the infirm
- (b) the disabled.

It stands to reason that a loyal worker who has been in long employment must get old; and when he does, he is often cast away by industry. At a time, when he has become highly skilled, his age disqualifies him to pursue his work. There is widespread concern that this state of affairs should continue. We, in our country can ill afford to waste skilled workers. A determined and sincere effort must be made to discover whether or not those who grow old in the service of industry cannot be re-employed. If on reassessment, their mental and physical co-ordination powers remain unimpaired, they must be allowed to continue in national service—for today, service to industry is service to our Nation. Some aged workers become crippled by disease. Such people require treatment and suitable rehabilitation. Alternative employment may be found for them. When they suddenly find themselves unemployed and inactive they become discontented and age very rapidly. Their morale decays and they become a public liability.

More tragic than the old people are those who are injured in the course of their work. An unexpected explosion, a forgetful second near a cutting lathe, an unguarded movement near a heavy press—all these result in instantaneous and crippling injuries,—often to the extremities, particularly the hands. It is superfluous to say that hand surgery comprises an important part of

industrial surgery. Such people who become injured are often healthy, active and wage earning members of the family. The accident is an economic blow and great financial hardship may result. Failure to treat them promptly may mean chronic disability, prolonged idleness, loss of morale and finally instead of contributing to public funds, they become a drain on it. Their family endures great hardship. It is a remarkable fact that by the use of great advances which have been made in accident surgery, most, if not all such patients may be rehabilitated. The results of skilled surgery based on sound principles of modern orthopaedic and plastic (Reconstructive) surgery is dramatic. The importance of functional rehabilitation as well as cosmetic appearance is understood. Even in severe and mutilating injuries it is encouraging to see the worker returns often to his original work and sometimes to an alternative type of work within a remarkably short period of time. It involves hard work on the part of those who make him fit for employment again. Rehabilitation is as important as surgery and therefore at the internationally renowned Accident Hospital at Birmingham the rehabilitation department occupies a considerable part of the hospital and is given as much importance as the resuscitation room, the theatre or the ward. Rehabilitation is of the greatest importance and a sound knowledge of what this can achieve must be possessed by the practitioner in occupational health.

CONCLUSION

The harmonious working of those who employ and direct, and those who do the work, guided by a tactful Personnel Manager and Social Relations Officer advised by the Industrial physician is not enough.

The State has to take a keen interest in industry and in the welfare of those who are employed in it. This is no place to enter into the details of industrial legislation; nevertheless it is important that the physician should be keenly concerned with, and possess efficient knowledge about industrial legislation, which has at heart the safety and welfare of the workers. He must see that the laws are strictly enforced and should bring to the notice of those who make laws, further protective measures which may guard and add to the well-being of the workers.

In the great industrial future which lies ahead of our nation the physician who dedicates his life to this particular branch of service has an important part to play.

An Appraisal of the Future Trend of Mosquito Control Measures

BY DR. HAROLD FARNSWORTH GRAY, Gt.P.H., F.A.P.H.A.

We have two general philosophies of vector control. One is to prevent the development of the vector by control of larval production places. The other is to place dependence upon killing the adult vectors. The latter method may appear spectacularly effective at the start and initially inexpensive. But will it remain always successful? Will it continue inexpensive? Can we learn from experience or must each generation learn through its own mistakes?

MANY years ago the playwright Eugener Walter wrote a drama of great popularity entitled "The Easiest Way". The moral of this play was that the easiest way a woman could earn a living resulted eventually in her social, moral and economic ruin.

Since 1946 many public health and nuisance prevention agencies have been following the "easiest way" to control the transmission of disease by various insect vectors, or to prevent the economic damage caused by pest mosquitoes. This "easiest way" has been by the

use of modern insecticides or remarkable potency, DDT being the exemplar. The basic concept that insect control could be accomplished most effectively by preventing the development of the larval forms of the vector or pest has frequently been abandoned for measures designed to kill the adult insects after they had been allowed to reproduce themselves, often in vast numbers. But this "easiest way" has many inherent dangers and can lead to disasters.

The remarkable effectiveness of DDT in rapidly reducing the incidence of malaria by residual spraying

ZIMAX

For ECZEMA and ATHLETE'S FOOT

Ref: 'Indian Practitioner', January 1954

1. Dr. T. K. MEHTA, M.B., B.S., F.C.P.S., D.V.D., B. Y. L. Nair Hospital, 'ZIMAX' is an Ayurvedic Patent. I have found it very useful for acute and sub-acute stages of ECZEMA.
2. D. J. A. FERNANDIZ, M.R.C.P.(Ed.), M.R.C.S., L.R.C.P.(Lon.), Bombay, 'ZIMAX' gave satisfactory results in four cases out of six. Two cases have not reported back yet.
3. MEDICAL OFFICER, New India Assoc. Co. Ltd. Fourteen cases in the staff were treated by 'ZIMAX.' Out of which twelve were cases of ECZEMA and two of ATHLETE'S foot. The Eczema cases were both dry and scaly type. Out of these ten cases were relieved of itching in a day or two and Eczema entirely disappeared in ten or fifteen days. The relief obtained by ZIMAX in Athlete's foot was very remarkable and a complete cure was effected in five or six applications.

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of dwellings has been, by its results, an almost unanswerable argument in favour of adult insect control by insecticides. In at least one case (that of *Anopheles darlingi* in British Guiana), this method, used alone, has been responsible for the complete extirpation of an important vector in a large area. Residual house sprays have also reduced *Aedes aegypti* to the vanishing point in many South and Central American countries, but the technics for its extirpation had been worked out prior to the advent of DDT. In the field of nuisance prevention, the application of insecticidal fogs or aerosols was also very effective at first in some areas, leading many abatement agencies to reduce their source reduction and larvicidal programmes in favour of extensive aerosoling. But a few years ago many species of mosquitoes in the *Culex* and *Aedes* genera began to develop a tolerance to DDT and related chlorinated hydrocarbon insecticides with increasing failure of adult control measures to give effective abatement. As far back as February, 1949, I branded this method of mosquito control not only as a "confession of failure", but as "an open advertisement of failure". As this method has failed to steadily increasing extent to give public relief from mosquito annoyance, in spite of increasing public expenditures, technical opinion as well as public opinion is coming to this view-point. "Temporary measures result in permanent taxation".

In the field of nuisance prevention, the substitution of temporary methods of adult insect control for the more permanently effective methods of larval control through elimination or restriction of the area of mosquito-producing water is not too serious a matter. The mistake can be corrected, after some waste of time effort and money, and some unnecessary public discomfort. In both Florida and California the failure of insecticides to prevent marked public discomfort is now forcing the mosquito abatement agencies to put increased effort into mosquito source reduction methods. But in the field of disease prevention, unnecessary sickness, and especially unnecessary deaths from a vector transmitted disease because of ill-advised and deficient preventive measures cannot be condoned. Explanations of the reasons the victim died are of little comfort to the corpse.

The very success of the residual spray programmes in many tropical countries is laying the foundation for an ultimate debacle of monumental proportions, if the inherent dangers are not recognised and adequate steps taken to prevent these dangers. Prior to the advent of the new insecticides, men like Watson and

many others had worked out by observation and experiment a number of effective and relatively simple larval control measures for the important anopheline vectors of malaria. Some were termed "naturalistic" methods and were designed by relatively minor changes in the environment to reduce the production of an important vector species in a particular area or region. Shading against *Anopheles minimus* and *A. maculatus*; clearing against *A. umbrosus*; salinification of marshes against *A. albimanus*; and freshening of marshes against *A. labrachiae* are examples. In addition, such mechanical measures as stream bed intermittent flushing have been successfully used in many areas. These are methods that can be installed and maintained with local materials, local labour, local intelligence and understanding of purpose and within local economic ability. They have been and can still be, effective in reducing the relative numbers of vector anophelines below that point at which an endemic malaria can be maintained in a community.

It has been, and still is, entirely proper and reasonable that the rapid reduction of disease transmission by mosquitoes should be effected by the residual application of DDT and similar insecticides. Lives are being saved and much sickness prevented by this measure. Its relatively low initial cost and relatively prompt results are great advantages, but sole reliance on this measure can, and probably will, result in a tragedy. It must always be kept in mind that another major war could stop the supply of modern insecticides to many if not all tropical and semitropical countries with disastrous results. Too great dependence on the insecticides will have resulted in loss of the knowledge and technics of the relatively simple naturalistic control measures, as well as drainage, filling and even oiling. With no DDT, in a few months the unrestrained hordes of mosquitoes would wreck havoc in a population which, because of recent relative freedom from infection, will have lost any acquired partial tolerance to malaria; the result may be astonishingly high death rates and morbidity rates.

It is also not inconceivable that a severe economic depression in the Western nations might also have a similar result by necessitating the stoppage of present assistance programmes.

There is also the possibility of the development of resistance to the chlorinated hydrocarbon insecticides by the various *Anopheles* species. They have been much slower to develop resistance than *Aedes* or *Culex* species, but there is no reason to believe they

(Continued on page 47)

ACUTE ABDOMEN

By DR. S. V. GHURYE, M.D., AND DR. I. KUPPUSWAMY, M.B., B.S.

THIS is an analysis of cases of Acute Abdomen admitted in the Singareni Colliery Company's Hospital during the last 2½ years. These are grouped in 5 main categories. (1) Poisonings, (2) Penetrating injuries of the abdomen, (3) Non-penetrating injuries (4) Other conditions simulating acute abdomen, and (5) Diseases of the abdominal organs.

POISONINGS

Six cases were due to swallowing of castor seeds—all children. They had acute epi-gastric pain and vomiting. No rigidity of abdomen and no diarrhoea. In some cases

(Continued from page 46)

will not ultimately do so. There are some present indications that resistance is developing in *A. quadrimaculatus*, for example. Perhaps the substitution of EPN (ethyl-O-p-nitrophenyl thiophosphate) may be the answer temporarily, but when will the mosquitoes develop resistance to the organic phosphate group of insecticides? Have we not got ourselves into a continuing "rat race" on this basis?

There is a further aspect of the problem worthy of consideration. In the United States of North America much practical emphasis has been placed on the control of pest mosquitoes for public comfort, even though lip service is usually given to the communicable disease aspect of the problem (e. g. Western equine and St. Louis encephalitis). In tropical countries, the emphasis, has been placed on, and generally limited to, the control of specific disease vectors and public comfort has been rather ignored. But one reason for the ready acceptance of the house residual spray programmes by the people benefited is the concurrent relief from other mosquito species within houses, as well as a reduction in flies, fleas, and other household pests. This increase in public comfort will, sooner or later, result in a widening and intensified public demand that public health agencies give attention to these aspects of public comfort, as well as to public health per se. If the health authorities will not or cannot give these services, public demand will sooner or later bring about the institution of special agencies outside the health departments to perform them. If we look upon public health as something more than the prevention of Communicable disease, there is no

there was no history of swallowing any articles but gastric lavage made the diagnosis clear. Oleander seeds—2 cases—both females. They were admitted for similar symptoms as above. The vomiting persisted and tachycardia and somnolence followed. One case developed gradual loss of consciousness and died. Post-mortem examination showed minute hæmorrhages in the gastric sub-mucosa and in the sub-endocardial region.

PENETRATING INJURIES OF THE ABDOMEN

These cases have been left out from the series as the cause was apparent.

reason why health departments could not extend their activities to related fields of public comfort, through well designed and executed measures for improvement of the environment.

We have two general philosophies of vector control. One is to prevent the development of the vector by such environmental control measures as will minimize the materials in which the vectors can reproduce. In fly control it is sanitation which removes and destroys or renders inaccessible the decaying organic materials in which fly larvae develop. In rodent control it is rat-proofing to prevent the nesting of rats, plus cutting off their food supplies. In mosquito control it is either the elimination of water in which larvae can develop or the rendering of unremovable water unsuitable to the development of a dangerous vector species.

The other philosophy is to put dependence upon killing adult vectors, frequently because these appear to be spectacularly effective at the start and appear to be initially inexpensive. But, will these methods always be successful, and will they ultimately be inexpensive? Can we learn from experience or must each generation learn the hard way through its own mistakes?

REFERENCE

1. Gray H.F. President's Address. Proc. & Papers 17th Ann. Conference California Mosquito Control. A., jointly with Am. Mosquito control A. 1949. p.28.

NON-PENETRATING INJURIES OF ABDOMEN

Six cases. One was found to be obly contusion and did not develop any complications. Second had fracture of the upper ramus of the pubic bone but no damage to the internal organs. 3 turned out to be cases of rupture of the spleen and splenectomy was done. In one case the ruptured spleen was 11" long and 6" broad. Sixth case turned out to be rupture of the jejunum. The patient gave history of fall and had pain in the epi-gastric region with rigidity and tenderness, there was no shock. X-ray examination showed gas under the right dome of the diaphragm. When the abdomen was opened there was only a small quantity of free fluid and a couple of chilly seeds but no other food material free in the peritonium cavity. First examination of the gastro intestinal tract did not show any perforation. There were flakes of fibrinous deposits adherent to the visceral peritonium at different places. Dislodging these, we came across a perforation size—1¼" x ½" having clear cut margins under one of them about 10" away from the duodeno jejunal flexure. The intestinal contents were like firm solid paste. The perforation was sutured. Our impression is that without operative measures this perfo-

ration would have healed by itself as it was effectively sealed by the fibronous deposit.

OTHER CONDITIONS SIMULATING ACUTE ABDOMEN

Coronary Thrombosis. A middle aged patient was admitted for acute epigastric pain and vomitting. He had generalised rigidity in the upper part of the abdomen and signs of shock and collapse. Scout film did not show the presence of intra-abdominal gas. Laparotomy revealed nothing abnormal. Subsequent observation showed that it was a case of Coronary Thrombosis. (2) *Hysterical Vomitting*: Young female was admitted for similar symptoms as above. Vomitting was persistent with pulse 120. After the period of observation it was decided to do a laparotomy which showed no abnormality except the presence of infantile uterus.

THE DISEASES OF THE ABDOMINAL ORGANS

100 cases—out of these 47 were operated and the rest were treated on conservative lines symptomatically. Following is the statistics of the operated cases.

Perforation in the gastro intestinal tract	9 cases
Acute Appendicitis	7 "
Intestinal Obstruction	12 "
Strangulated Hernia	8 "
General Peritonitis	2 "
Ruptured Ectopic	6 "
Ruptured Uterus	1 case
Secondary Abdominal Pregnancy	1 "
Sub-diaphragmatic abscess	1 "

COLONIC PERFORATION

A previously healthy young man was admitted with acute pain in abdomen for 3 days duration and of sudden onset. He showed signs of general peritonitis with free fluid in abdomen and moderated leucocytosis. A scout film of the abdomen taken in erect posture did not show any free gas. Laparotomy showed presence of a big solitary amoebic ulcer in the ascending colon, which had perforated. Previous to the onset of the present condition the patient was working normally and did not give any history suggestive of dysentery.

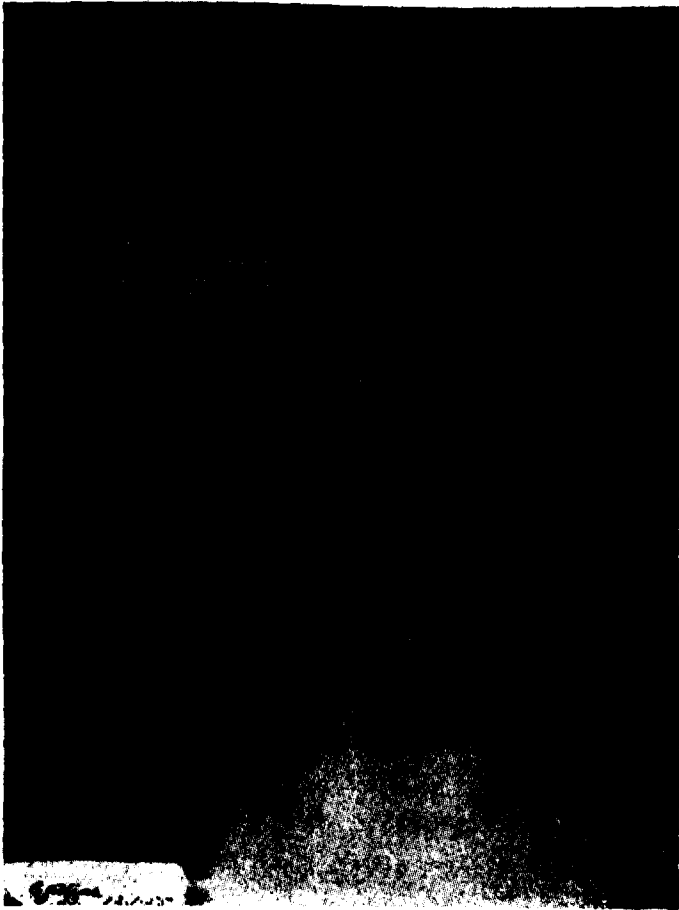
The second case was that of a young man who had acute attack of abdominal pain for 6 days. He had about one vomit per day. The history was suggestive of intestinal obstruction. Clinical examination showed signs of general peritonitis with free fluid in abdomen and epigastric distension due to a cyst like swelling in the middle of the upper abdominal area. Temperature was



Intestinal obstruction showing fluid levels in the small intestines.

PERFORATION OF THE GASTRO INTESTINAL TRACT

Of the 9 operated cases, 6 survived and 3 died. 2 were colonic perforations, one was jejunal of traumatic origin described above and 6 had perforation in the gastro duodenal area.



General Peritonitis with Ileus showing distended loops of intestines but no fluid levels.

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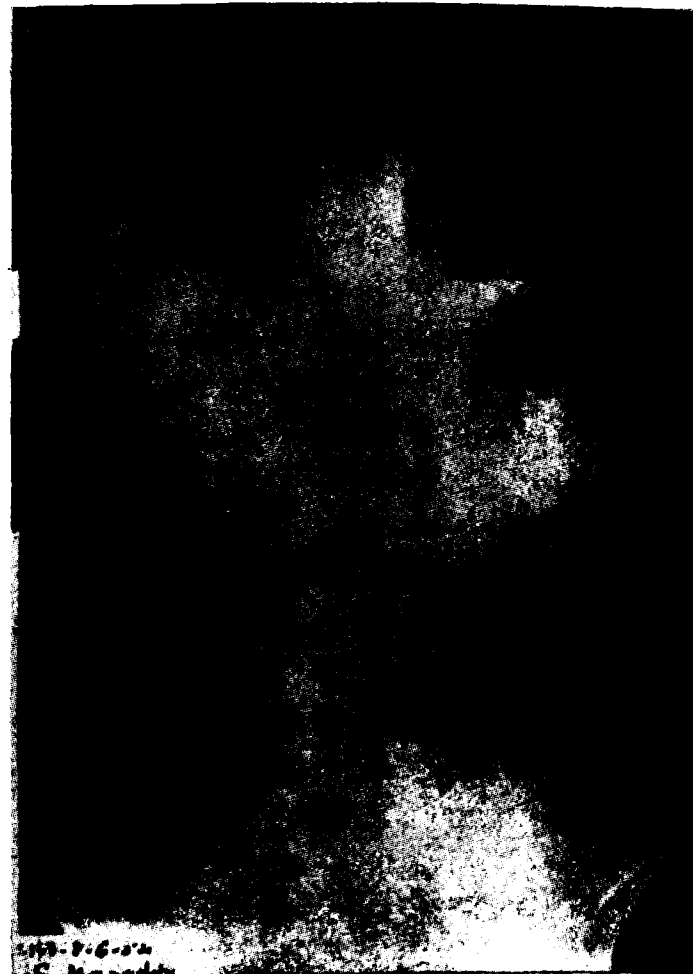
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99°F and pulse 140. Scout film did not show any free gas in peritonium but showed the distend colon with a fluid level, stretching across the whole width of the abdomen. Continuous gastric suction did not bring out any fluid or gas. Operation showed presence of general peritonitis from a leak in the distended portion of the transverse colon. The descending colon was collapsed. Transverse colon was enormously dilated, size of a coconut and there were large areas showing early gangrene. The site of obstruction was near the splenic flexure.

PERFORATION OF PEPTIC ULCER

6 cases—2 were in the stomach along the lesser curvature and 4 in the duodenum. They were admitted with history of acute pain in the epi-gastric region of varying durations from few hours to 2 days with previous history suggestive of peptic ulcer. Examination showed presence of tenderness and rigidity in the upper part of the abdomen and the scout film showed presence of the gas



Jejunal perforation showing gas under the diaphragm. 2-X-ray films of the same patient.



under the right dome of the diaphragm in 4 cases. All of these were operated and the perforation sutured. In 2 cases the duodenal perforation was more or less firmly closed by fibrinous deposit. There were 8 cases admitted with similar history as the above but were not operated. 2 of these cases were under treatment off and on for duodenal ulcer and they used to get subsided after a few hours. But the present attack, they said, was unprecedented in severity. There was tenderness and rigidity of the right side of the abdomen which was scaphoid with signs of shock. Clinically there were signs of obliteration of the liver dullness but a scout film did not show presence of gas under the diaphragm. Early cases suggestive of perforation of peptic ulcer are treated here on conservative lines of treatment for a few hours and operation is undertaken if the condition deteriorated. Expectant line of treatment consists of putting the patient in Fowler's position, continuous gastric suction and intravenous administration of glucose and saline and parenteral administration of anti-biotics. These 2 patients

gradually recovered from the state of shock. The pain subsided during the next 24 hours, oral feeds were started on the 3rd day and they were discharged in the course of time. It is possible that the above 2 cases were due to a ruptured duodenal ulcer which had healed by itself.

APPENDICITIS

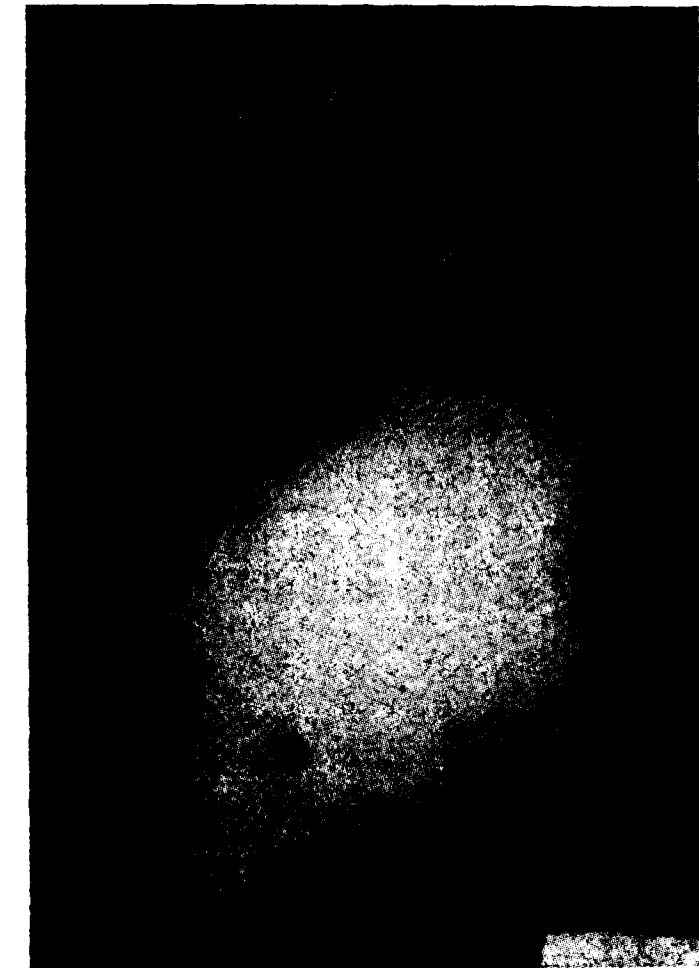
7 were operated and 16 were treated on conservative lines. Of the operated cases 3 had acute appendicitis, 2 had gangrenous appendix and 2 were perforated appendix with local peritonitis. 16 were treated on conservative line, for one reason or the other. 2 of them had similar attack 6 months back.

INTESTINAL OBSTRUCTION

12 cases were operated and 8 cases suggestive of intestinal obstruction were treated conservatively. Operated cases—6 were due to constricting bands. One was



Perforation colon due to amoebic ulcer. There is no gas under the diaphragm and there are no fluid levels in the intestine.

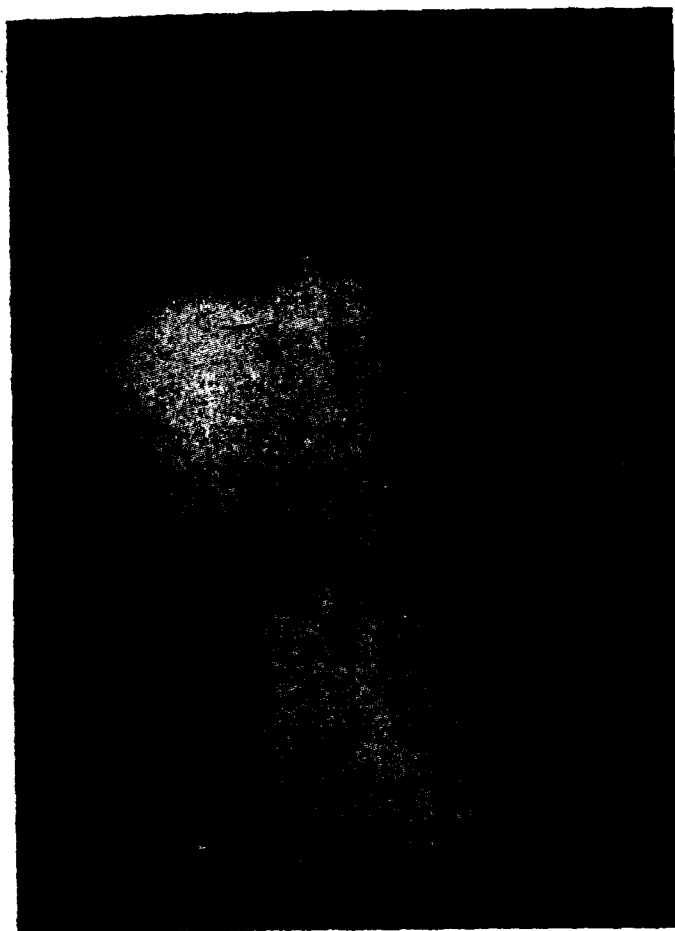


Obstruction and subsequent rupture of the transverse colon showing dilated transverse colon and a fluid level.

due to a band in connection with TABES-MESENTERICA. One was due to spastic ileus and 4 were due to volvulus of the small intestine. Out of these 4 died. These had come between 4 and 6 days after the onset. There were 8 cases suggestive of intestinal obstruction but under observation the pains subsided and no further action was necessary.

SPASTIC ILEUS

He was admitted for acute abdominal pain and vomiting of 5 days duration. Clinically and radiologically it was a case of obstruction. During the operation no constricting band was seen, nor was there any volvulus, nor was there any evidence of obstruction in the lumen. The dilated loops were seen to gradually merge into the spastic pallid grey looking loop and the distal portions of the intestines were collapsed.



Scout film showing distended loops of intestine in the upper part with no fluid levels. There is no gas under the diaphragm.

VOLVULUS OF THE SMALL INTESTINE

4 cases—In these cases the abdominal pain and vomiting was of 3 or 4 days duration gradually increasing in severity. They showed central distention and fluid levels in the scout films. They were operated on and the volvulus corrected.

RENAL COLIC

8 cases—Out of these only one had stone in the pelvis of the kidney, one had a floating kidney and in six cases no stone could be demonstrated. Out of the above, one had reflex anuria lasting for 5 days. Total urine in 24 hours was about $\frac{1}{2}$ ounce, which was highly coloured showing some crystals of uric acid but no R. B. C. He had considerable restlessness and couple of vomits per day and pain and tenderness in the right lumbar region sufficient to make him roll about. Diuresis started on the sixth day and further progress was uninterrupted—X-ray did not show a calculus. Descending pyelography was not done on this case. It is possible that he had a calculus which was not radio-paque.

RUPTURED ECTOPIC

There were 6 cases of varying durations from few hours to 2 days. All were operated and the result was satisfactory.

NEW VACCINE TO FIGHT POLIO MENACE

Latest studies on an anti-polio vaccine have provided the most suggestive evidence obtained so far that a new immunity agent prepared with killed viruses of three types of polio will bring to a definite end the crippling form of the disease as soon as the susceptible age groups are properly vaccinated. This may mean the end of one of the greatest scourges of mankind, acripler of young and old alike, within the next five years or less.

In a paper presented to the annual meeting of the Association for Research in Nervous and Mental Diseases Dr. Jonas E. Salk, originator of the tripple vaccine, told the authorities that the vaccine, if properly prepared and administered could produce an immunity considerably more potent than the immunity provided by natural infection. (*"The New York Times"* & *"The Times of India"* News Service)

Interviewed by reporters who were smoking everything from Cigars to pipes, Giovanni Martinelli, the operatic star, pleaded "No smoking in my presence, please. It makes my throat sore".

A Newspaperman spoke up. "But didn't you endorse a cigarette once? Seems I read such advertisements".

"Si, Si", replied the smiling Star, "but recall what I said in that advertisement? "These Cigarettes never make my throat sore"; and that's true. But I never smoke them. I never smoke anything".

MEDICAL NOTES & NEWS

NEW INSTRUMENT MAKES POSSIBLE PAINLESS SELF-INJECTIONS

Boon to Diabetics

A new medical instrument which has been described as the greatest boon to diabetics since the introduction of insulin has been invented by a Scot who is himself a diabetic. It is a 'gun' with a hypodermic syringe attached, enabling patients to give themselves completely painless injections. The instrument has been subjected to extensive tests with many kinds of patients, including neurotics who suffer most psychologically when they have to give themselves injections.

Operated by either hand, the 'gun' can be used for injections in any part of the body. The base plate has been designed to gather the skin unaided in preparation for the injection; the high forward speed of the needle, obtained through a contracting spring, and the controlled depth of penetration combine to produce a highly

efficient and non-varying injection. The instrument is precision-manufactured in stainless steel.

The new instrument is finding uses not envisaged when it was first designed, and a number of modifications for specific projects in medical research are under consideration. After clinical tests, many British hospitals are using the injectors for the routine administration of penicillin, anti-diphtheria serum, and insulin. There have been particularly favourable reports on the use of the instrument in Children's and school clinics, and it has been found efficient for both subcutaneous and intramuscular injections.

* * * * *

RADIO-ACTIVE COBALT 'GUNS' FOR HOSPITALS

For its fight against malignant diseases, a Welsh hospital is arming itself with the latest weapon—the radio-active Cobalt Gun. Two of them are to be

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installed in a new radio-therapeutic department of Whitchurch Hospital, Cardiff.

They will be the first to go into a provincial hospital and so far the only cobalt guns operating in the United Kingdom hospitals are in London.

"Cobalt Guns" each of which weigh many tones, are intended to take the place of deep X-ray therapy. The units at Cardiff will be installed in a chamber with walls three feet thick, and will be operated by remote control. Special devices will allow operators to keep patients under observation while the treatment is proceeding.

* * * * *

UNBREAKABLE SPECTACLE LENSES

Spectacles are a hazard in certain industries—but one that is decreasing with the wide adoption of unbreakable lenses manufactured by a British firm.

The lenses, made of normal optical glass but toughened by head treatment, will withstand repeated blows, and one of which would shatter a conventional lens. Each is submitted to rigorous tests that are in excess of official requirements and include the dropping of a steel ball on the lens from a height of 4½ ft. The ball is 7/8th inch in diameter and weighs 1½ oz.

* * * * *

INDIAN DOCTORS TO VISIT CHINA—LECTURE TOUR OF SIX WEEKS

A five-man-team of Indian Medical Experts will visit China in early June on a six-week lecture tour of the country at the invitation of the Chinese Government. The team will comprise Co. Ahuja, Director, Central Research Institute, Kasauli, Col. Jaswant Singh, Director, Malaria Institute, Delhi, Dr. Chowdhary, Director, Calcutta School of Tropical Medicines, Dr. Patwardhan, Director, Central Nutrition Institute and Dr. Krishnan, Director, Institute of Hygiene & Public Health, Calcutta.

While in China, the medical experts are expected to visit hospitals, medical institutes and health centres. The Chinese invitation was received by the Government of India in the first week of February.

* * * * *

ARTIFICIAL HEART STIMULATOR SAVES WOMAN'S LIFE

An artificial heart stimulator, conceived at Beth Israel Hospital in the United States of America, has been used to bring a woman back to life nine times. Mrs. Colin McKenzie, 57, is but one of the more than 20 persons who owe their lives to the revolutionary device developed in 1952 by Dr. Paul Zoll, Associated Professor of Medicine at Harvard Medical School.

The case of Mrs. McKenzie is singular only in that the 13-pound box-shaped device was used to stimulate the heart on nine different occasions. A patient at Boston City Hospital she is reported in fair condition. She was admitted to the hospital in December 22, 1954 and has had the life-saving device strapped to her chest since that time.

In most of the 20 cases in the area, the patient's heart-beat had ceased on more than one occasion. Quick application of the machine-known as the Pacemaker-had re-started the heart and maintained a regular beat until the heart itself resumed its normal pulsation.

The Pacemaker consist of a metal box equipped with a pair of disk electrodes. The machine is portable.

When a patient is in need of the machine, the electrodes are strapped across the chest—one over the apex of the heart and the other on the opposite side. The machine is then activated and an electrical impulse of short duration is sent out.

The impulse stimulates the heart muscle and enables it to contract thus replacing the vital organ's lost impulse. The attending Physician merely feels for pulse. A light on the device flashes each time the pulse beats.

Recently a device was developed which automatically starts the Pacemaker if the patient's heart stops. This attachment, called an alarm system, is now ready for sale. There is a great demand for the Pacemaker in hospital operating rooms—particularly during the period when a patient is under anaesthesia.

Dr. Paul Zoll who is full-time visiting physician at the Beth Israel Hospital, presented his scientific exhibit at the Second World Congress of Cardiology, held in Washington in September last. He is scheduled to present a paper on his subject some time in May at the annual gathering of the American Medical Association.

* * * * *

SUCCESSFUL EXPERIMENTS FOR THE CONTROL OF THE COLOUR OF THE HUMAN SKIN

Three Scientists, Drs. Aaron Bunsen Lerner, Kauzuo Shizume and Kirby Bunding have clearly demonstrated that substance secreted by the pituitary gland controls the colour of the human skin. It was a climax to many years of study by many scientists which may some day give man the know-how about his own body chemistry which will enable him to have whatever skin shade he wishes to have.

These Scientists darkened the skins of seven persons by injecting them with the pituitary glandular substance which had been extracted from the glands of hogs. Four of the seven were whites, three were Negroes.

Writing on this subject in the Journal of "Clinical Endocrinology and Metabolism" these Scientists discuss at great length the possibility of controlling the colour of the human beings by scientific means. Dr. Bunding of Armour Laboratories Chicago, by complex chemical purifications, managed to produce a pituitary extract which was more or less free of the known pituitary hormones such as ATCH and was mainly the colouration substance but not in pure form. This substance Drs. Lerner and Shizume used in their experiments with experimental animals and with human beings at the University of Oregon.

This substance they reported definitely contained a hormone - the melanocyte-stimulating hormone or MSH. Melanin is the pigment of the human body - thus the hormone stimulates colour forming cells to take up more melanin.

It was also found that of the injected MSH one to four percent was excreted. "The hormone is either rapidly destroyed or bound by tissues", they said. In some of their human subjects a pronounced darkening of the skin was observed within hours after the hormone was injected.

Their studies gave evidence of how the shade of human skin is decided by nature. The pituitary secretes MSH but the adrenal glands secrete hydrocortisone which slows the pituitary's secretions of MSH. And the adrenals also secrete adrenaline which slows the response of the pigment-forming cells to the MSH which has already reached them.

The shade of the skin thus is a matter of balance among these internal secretions. The scientists believe

that man might some day know enough to change the balance at will. However, the work which remains to be done is enormous - and this the doctors noted in their report.

* * * * *

INCREASE OF DOCTORS IN THE UNITED KINGDOM: SURPLUS FEARED?

Britain is producing so many doctors that there may be a surplus of 5,000 to 6,000 of them by 1959 warns Dr. R. L. Newell, Dean of Post-graduate Medical Studies at Manchester Universities. Writing in the "Medical School Gazette", Dr. Newell says that during the last 10 years there has been an average increase of 2,048 physicians and surgeons on the Medical Register although 20 per cent of this figure is accounted for by Commonwealth and Irish registrations. Since 1933, the number of the Register has jumped from just under 60,000 to more than 80,000 "an alarming prospect".

* * * * *

Prof. R. Hoffmann, 74-year-old lecturer at the Zurich and Geneva Hospitals and the founder of the transcuteaneous method of treating bone fractures gave practical demonstrations of his system recently in Hyderabad. His method consisted of the use of fine, stainless steel screws to hold the splints and the fractured bone in position. After a fractured bone is set the limb is held in position by splints. The fine screws are pierced through the splints and the limbs on either side of the fracture so that the broken pieces of bone do not separate after being set.

This technique according to Prof. Hoffmann is useful in cases of delayed unions of bones and for treating open fractures. The greatest advantage of this method lies in the fact that the skin and the flesh are not required to be cut.

* * * * *

MALARIA CONTROL OPERATIONS IN INDIA FOR 1955-56

The Foreign Operations Administration has announced recently an agreement with India to extend Malaria Control to an additional 11,000,000 persons as part of its technical assistance to India during 1955.

The announcement said that India's nation-wide malaria control programme was the largest of its kind in

the world, with 125 control units now providing protection to approximately 100 million persons.

The United States' contribution in the present instance amounts to \$ 4,400,000 (Rs. 22,000,000) and India's contribution to this phase is (Rs. 22,000,000).

* * * * *

WORLD HEALTH ORGANISATION'S PLAN FOR PROTECTING PUBLIC

Health Against Radiation

The World Health Organisation is giving top priority to a new programme for the health protection of populations against radiation of atomic energy. The first step is the preparation of a detailed report on what measures it is considered should be taken by Governments for the adequate protection of workers and city dwellers. This report is to be presented to the forthcoming world conference on the peaceful uses of atomic energy which opens in Geneva in August this year.

In their preliminary report the WHO experts have divided the first phase into six main heads:—

1. Studies of radiation-induced diseases: Extensive studies are in progress already but Governments should collaborate in the exchange of information as there is much to be learned from further investigations.

2. Disposal of radio-active waste material: Although upto the present the situation is not alarming a potential danger is to be envisaged when a great number of atomic plants are established and when a great number of laboratories throughout the world start working with radio-isotopes.

Problems of contamination of water by liquid waste, of air by volatile materials of the soil and the sea by solid waste, disposed of in the ground or on the sea bed have to be envisaged. The location of reactors and their access to the sea or to rivers and also the problem of density of the population in the area must also be studied.

3. Nuclear Reactor Safety: There is a potential danger for the general population resulting from

accidents always possible in any kind of reactor; preventive measures against this risk, including the problem of appropriate location, should be considered at the planning stage.

4. Health problems of uranium mining: This is a special aspect of occupational health in the mines resulting from the carcinogenic effect of radio-active materials present in the atmosphere and the dust of the mines.

5. Transport of radio-active material: This includes the problem of transport of critical materials to or from the atomic energy plants and the problem of transport of radio-isotopes.

6. Standards for radio-active materials and establishments of units of radio-activity: In view of a scientific study of the problems of protection, it is essential to solve this problem to which a great deal of attention has already been given and which is a condition for the accurate measurement of irradiation dangerous to man.

With regard to the medical uses of radio-isotopes the WHO Expert Panel sub-divided this section into four main points:—

1. Use of Radio-isotopes in therapy: New developments, now taking place, raise a problem both of research and of training of personnel for its application.

2. Use of radio-isotopes in diagnosis: There are already a few accepted tests with radio-active material, but this use will certainly expand. There is a problem of research on new diagnostic tests and also a problem of a possible influence on genetics (heredity) of the radio-active material used for such tests. Mention should also be made of the possible use of radio-isotopes in small X-ray machines for diagnostic purposes.

3. Use of radio-isotopes in medico-biological research: This is a very wide field and one cannot see any limit to it except the limit of human imagination. In genetics, nuclear radiation has already been applied for the acceleration of mutation processes, for the development of strains of plants more resistant to diseases. Some similar method might be applied to accelerate mutation in viruses in order to obtain more potent vaccines. Also,

the use of tracers is of great importance in the study of movement and behaviour of animals as carriers of human diseases.

4. Small reactors for research in biology: The extensive use of radio-isotopes in biological research raises the question of small atomic reactors which could be a reliable source of radiation for purposes of research. This in turn raises a question of pooling sources of countries which could not afford the construction of such a reactor of their own.

* * * * *

NEW BRITISH THYROID CLINIC USING RADIO-ACTIVE IODINE

Substantial additions costing £. 50,000 and consisting of a thyroid clinic and a department of endocrinology were opened recently by the Duke of Edinburgh at New End Hospital, Hampstead. The hospital's thyroid unit, started in 1932, is the foremost centre of thyroid surgery in the United Kingdom, and is now world-famous. There, in the past few years, study of the endocrine system of ductless glands—of which the thyroid and thymus glands are part—has been assisted by the use of radio-active iodine for research and treatment. An isotope and bio-chemical laboratory was added to the clinic in 1952 and since then over 700 patients have been examined or treated with radio-active iodine.

MASS PRODUCING ANTIBIOTICS

The discovery of penicillin 25 years ago and the ever increasing production of antibiotics has led to the creation of a vast new industry in which bacteria, moulds and other micro-organisms are used to manufacture not only drugs for medical use but also chemicals for a variety of commercial applications. Although the production of antibiotics on a commercial scale is not the first time that micro-organisms have been used industrially (they are after all the basis of both brewing and wine making), the advent of the large antibiotic producing factory has created a number of unique problems.

Production Rate

The rate at which the moulds or other organisms reproduce themselves must not only be encouraged but also controlled, for under ideal conditions the growth of cultures of the moulds from which antibiotics such as penicillin, streptomycin, aureomycin or the latest

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addition to the range of commercial antibiotics achromycin are extracted, can be stupendous. Something of the order of the rates of reproduction can be gathered from the fact that a single bacterium cell may produce as many as 17m. other bacteria cells in 12 hours, thus in effect multiplying its own weight 17m. times.

Obviously a process which creates new material as fast as his cannot be allowed to get out of hand when it is being undertaken on the immense scale that is found in 10,000-gallon or 15,000-gallon fermenting tanks, such as are used by Glaxo Laboratories, Britain's largest manufacturer of penicillin, or Boots Pure Drug Company, where the fermentation of aureomycin producing mould is undertaken for Lederle Laboratories prior to the final purification and production at Lederle's Hirwaun factory. Because of this, such conditions as the temperature and acidity inside the 20-foot-high fermenting tanks must be very strictly controlled. In the case of most antibiotics the temperature in the fermenters must be kept as close as possible to 24 degrees centigrade.

Each antibiotic production plant has a master culture of, say, *Streptomyces*, or *Penicillium*, and the process of manufacture is started by taking a small flask of freeze-dried spores of the mould and adding them to a food solution inside a 10-gallon tank. When this tank is filled with mould this new larger culture is run through carefully sterilised air-tight pipes into a 100-gallon tank. Later on this in turn is blown by means of sterilised air (or run down by force of gravity) into a 1,000-gallon tank. This latter 1,000-gallon culture is then used to inoculate the food liquid in which the antibiotic material grows inside the large 10,000 or 15,000-gallon fermenting tanks which yield the commercial product.

Fermenting Process

Throughout the whole fermenting process the mould has to be agitated by means of blades or propellers driven by a motor of 200 or 300 horse power in order to ensure that the mould and the food material are evenly mixed. When the material is removed from the fermenter the relatively small quantity of chemical material—the true antibiotic—produced by the growing mould must be separated from the unwanted mould vegetation which has created it. The difficulty of industrial production is complicated by the fact that the purity of the antibiotic chemical must be assayed at every stage of the subsequent processes of filtration, concentration by evaporation, crystallisation, freeze-

drying, and its final incorporation into capsules, tablets or ointments. Through all these processes stringent precautions must be taken to ensure that the final product is virtually 99.9 per cent pure.

The development of all these techniques involves unusually high expenditure on production plant and laboratory analytical equipment, and this is one of the causes of the relative expensiveness of antibiotics as compared to some other drugs. The immense reduction, in price which has taken place within the last seven or eight years has been largely due to improvements in these manufacturing processes and in the reduction of wastage due to failure of controls or impurities. The most striking price reduction has been that of *Glaxo's Penicillin* which in 1946 cost 105s for a 5m. unit, but which now costs only 15s for the same amount—a truly immense reduction.

Each antibiotic is made from a single strain of mould; aureomycin, for example, is made from the mould *Streptomyces aureofaciens*, but many different strains of most of the better-known antibiotics, such as penicillin and aureomycin have now been bred, each one of which has slightly different qualities. Something of the task involved in creating new antibiotics can be judged from the fact that before terramycin was discovered in 1950, over 100,000 soil samples containing moulds had to be investigated.

While the production of antibiotics is increasing—penicillin production has increased from 358.1 thousands of mega units per week in 1949 to 1872.3 thousands of mega units per week in 1953—the uses to which they are being put is also becoming more diverse. Aureomycin is being used to improve the fattening of pigs and also, experimentally, to prevent the development of galls on the roots of tomato plants. Streptomycin mixed with lanolin prevents the formation of certain kinds of blight on beans. There can be little doubt that as research and production continue to increase, many more important uses for these relatively new materials will be discovered.

(The Scientific Correspondent—"The Financial Times")

CANCER HOSPITALS PRESENTED TO GOVERNMENT

World Health Day Gift

Hyderabad-Deccan: The Cancer Hospital and Radium Institute, built by the Hyderabad branch of

(Continued on page 59)

Some Aspects of Disposal of Industrial Waste Waters

By S. C. PILLAI AND C. ANANDESWARA SASTRY

Department of Biochemistry, Indian Institute of Science, Bangalore

ONE of the serious problems arising from the rapid increase of population and of industry is the hygienic disposal of enormous quantities of sewage and industrial wastes. For the disposal of these wastes by land treatment vast areas of land may be required. At certain centres land may not be available at all or its cost may be prohibitive. Alternatively, adequate quantities of water are necessary for the disposal of the wastes by dilution, but enough water may not be available in certain areas, especially in inland towns and cities. It was in view of the limitations of these two main methods of disposal of the wastes that scientific study of the whole problem began about a hundred years ago. The early attempts were mostly confined to the treatment and disposal of domestic sewage, and during the second decade of this century great advances were made in the purification of sewage. But the subject of treatment of industrial wastes was lagging behind, and little was known about the behaviour of trade effluents, e. g. when mixed with domestic sewage. Thus was caused a somewhat mysterious breakdown in one of the early activated sludge plants in England where flushes of brewery wastes and gasworks liquor were liable to enter the sewer.^{1,2}

Domestic sewage is, in a sense, a natural waste water; it contains organic matter and other ingredients similar to those present in soil, and indeed evidence has been accumulating that the changes taking place during sewage purification are comparable to those occurring in fertile soil, one of the main differences being that they proceed more quickly in sewage. Industrial wastes, however, contain chemicals and other substances, which, at any rate in quantity, are not found in ordinary soils and waters. If, therefore, the waste products from the various manufacturing processes are introduced as such

into sewage, soil or water, the natural changes in these systems are arrested temporarily or upset permanently depending upon the nature and quantities of the trade wastes. Pre-treatment of trade effluents is thus necessary in most cases and especially when large quantities of them have to be disposed of. The character and composition of the different industrial wastes have been studied by a number of workers and excellent accounts of these are available.^{3,4}

Almost all industries discharge waste waters from some stage of their manufacturing processes, and the waste materials may range from highly acidic pickling wastes to highly alkaline kier boiling wastes from the textile industry. Survey of 29 States in America by Cohn (1949)⁵ showed that at least 23,300 industrial concerns discharged liquid wastes in those States. In countries like the U. S. A., England and Germany, where there is congestion around industrial towns, pioneering work has been done on the methods of treatment of industrial wastes. In view of the increasing demand for water of good quality for domestic and industrial purposes and in view of the necessity of preserving the purity of surface and underground waters, these countries have laid down and enforced stringent regulations in regard to treatment of industrial wastes before they could be safely discharged into a watercourse. Commissions have been set up from time to time to review the standards of sanitation and degree of treatment that trade effluents should receive in the light of advances made in the biochemistry of sanitation. Public Health Service laboratories for the study of water purification, sewage and industrial waste treatment, and stream sanitation problems were established in Cincinnati, Ohio, in 1913, and have been in continuous operation since that time. In 1927 a permanent organisation, the Water Pollution

(Continued from page 58)

the Indian Conference of Social work was gifted to the Hyderabad Government recently. The function was jointly organised by the World Health Organisation and the Indian Conference of Social Work to celebrate World Health Day.

Presenting the half-finished building of the Cancer Hospital to the State Public Works Minister, Hon'ble Dr. G. S. Melkote, Nawab Mehdi Nawaz Jung,

Hyderabad's Public Health Minister sought the permission of the State Government to hold a raffle every year in aid of public charities.

Accepting the gift Dr. G. S. Melkote said that it was significant that the hospital should be handed over to a medical man, which was in itself a guarantee that the work so nobly begun by non-medical men would be completed satisfactorily.

Research Laboratory in the Department of Scientific and Industrial Research, was set up in England in order to study problems bearing on the quality of water. Interest in reducing the polluting effects of industrial wastes is growing rapidly in almost all parts of the world. Occasionally valuable products are recovered from trade wastes, but generally the industries have come to look upon the cost of treatment of their waste waters as a part of their manufacturing cost.

It may be pointed out in this connection that interest in the subject of industrial waste treatment has been evinced in India since the beginning of this century. In 1909 the Municipality of Bombay invited the late Dr. G. J. Fowler, who was then the Consulting Chemist to the Rivers Committee of the Corporation of Manchester, to study the question of admission of trade effluent into sewers; Dr. Fowler submitted his report on the subject to the Municipality in December 1909. The industrial centres in India were comparatively very few, but in recent years industrial development has been taking place and the necessity for a Central Water Pollution Research Laboratory for more intensive study of the problems of water supply and treatment of sewage and industrial wastes has been emphasised. ⁶⁻⁸

In the following paragraphs an attempt will be made to indicate the polluting character of trade effluents, the methods employed in the different parts of the world for their treatment and disposal and a future line of development.

POLLUTING CHARACTER OF TRADE EFFLUENTS

The polluting effects of different types of wastes when discharged into a stream are very complex. Some wastes are directly toxic inasmuch as they contain toxic substances like phenols, cyanides and metallic ions which are poisonous. Others contain polluting organic matter which deplete dissolved oxygen when discharged into a watercourse and thereby affect the plant and animal life in the water. Some wastes are coloured and have very offensive odour, and they render the streams unsightly. Undesirable effects like the deposition in the form of sludge banks are produced by wastes containing large amounts of suspended matter. The wastes which are highly acidic or alkaline interfere with the biological processes occurring in natural waters. Stream pollution thus affects not only the health of the community and industry, including fisheries, but navigation and recreation. A few of the specific observations on these aspects reported from different parts are given below.

Kammann (1929)⁹ observed that tanneries were likely to discharge pathogenic bacteria, such as anthrax spores derived from foreign hides. In an investigation into the loss of productive capacity of about 100 acres of paddy fields in the neighbourhood of a tannery near Madras, Iyer *et al.* (1952)¹⁰ analysed a number of samples of tannery effluents, soils of the paddy fields, the subsoil waters and related materials, and collected evidence that the salts and other constituents of tannery effluents were responsible for the deterioration of the soil in the affected belt of the land and for the failure of crops. Weldert and Kohlshutter (1938)¹¹ studied the effects of different types of polluting material with special reference to industrial wastes. An estimation of the amount of a given waste that might be discharged into a stream without damage could be obtained from the Biochemical Oxygen Demand (B. O. D.) of the effluent and the dissolved oxygen content of the water.

Mohle (1934)¹² described the effects of textile wastes on stream sanitation: putrescible organic matter promoted fungal growth and thereby depleted oxygen; dyes imparted colour to the water; and oily wastes prevented re-aeration and thus affected the self-purification of the stream. Waser *et al.* (1934)¹³ reported that introduction of industrial wastes into river Glatt caused death to fish and illness to the cattle which drank that water. Warrick (1934)¹⁴ studied the pollution of streams caused by pulp, paper and milk wastes. Although sulphite and sulphate pulp mill wastes were both toxic to fish in dilution less than 1 in 200 by volume, sulphite wastes due to their greater oxygen demand probably affected fish life even in greater dilution. Liebman (1938)¹⁵ studied the effects of discharging waste waters from a sulphite cellulose factory into river Saele just above the reservoir on the composition of water in the reservoir. The water was turbid and was having unpleasant odour. Fish were found to be dead. Although the sulphate cellulose waters were not toxic to plant and animal life in a stream, their oxygen demand and the formation of hydrogen sulphide from sludge deposited by the wastes caused damage to fish. Hora and Nair (1944)¹⁶ studied the pollutional effect of quinine factory wastes on streams and concluded that if adequately diluted with fresh water, these wastes were harmless to fish life. They pointed out the desirability of removing bark residues, as far as practicable, from the effluents by sedimentation, and mineral oil by skimming, and suggested that the discharge of the effluent into the streams should be spread over a period of time. Ganapathi and Alikunhi (1950)¹⁷ investigated the pollutional effects of effluents

from the Mettur Chemical and Industrial Corporation Ltd., on the fisheries of river Cauvery. These effluents containing a high percentage of suspended solids, fatty substances, calcium compounds and free chlorine were found lethal to fish life even if diluted 100 times with fresh water.

Davis (1938)¹⁸ reported that acid wastes slowed down self-purification besides causing corrosion to concrete structures in the river. In a symposium (1938)¹⁹ on stream pollution of river Ohio, Morgan reported that acidity of water inhibited bacterial growth.

Kunze (1939)²⁰ observed that cellulosic waste waters produced growths of fungi, reduced the pH value and depleted dissolved oxygen. Stundl (1943)²¹ observed that self-purification of polluted river water was delayed if waste waters from different factories such as pulp mill were present. Kalabina *et al.* (1944)²² investigated the effect of toxic substances in waste waters from non-ferrous metal industry on biological and biochemical processes of self-purification of waters in storage basins and reported that 0.1 mg./litre of copper or lead caused an appreciable decrease in bacterial numbers. Rogovskaya (1947)²³ reported that self-purification in a stream was inhibited by introducing more than 1 mg./litre of T. N. T. Ganapathi and Gnacko (1952)²⁴ reported that combined effluent from bamboo, rag and waste paper pulping operations created heavy local pollution of the Godavari river at Rajahmundry; as a control measure they suggested rough sand filtration or impounding with discharge during flood stage.

THE METHODS GENERALLY EMPLOYED FOR THE TREATMENT AND DISPOSAL OF INDUSTRIAL WASTE WATERS

Almost all the methods that are used for sewage treatment are generally employed for the treatment of industrial waste waters. In addition to these general methods, other ancillary operations, such as segregation of strong wastes from weak wastes, equalisation by mixing and mutual precipitation, regulation of flow and re-orientation of factory operations to reduce harmful wastes produced, are also practised. The choice of a particular method of treatment would depend upon the nature of the trade effluent and the extent to which it should be purified before it could be safely disposed of.

In this connection it is of some interest to note the observations of Iyer *et al.* (1951-52) who reported (a) that in considering the treatment and disposal of wastes at a given centre, a close study of the local conditions would be very useful and that as far as possible at the same

centre such of those industries might be located as would benefit one another, among other ways, in the treatment and utilisation of the different waste materials;²⁵ (b) that when discharging waste waters from breweries and cotton textile mills into municipal sewers, dilutions of over 30 times and of six times, respectively, with domestic sewage might be obtained if purification should proceed in the sewage-trade effluent mixtures;²⁶ and (c) that one of the important factors governing the purification of industrial waste liquors along with domestic sewage by rapid biological methods, such as the activated sludge process, is the reaction of the mixtures which should be nearly neutral.²⁷

Seth and Bhaskaran (1950)²⁸ conducted a survey of in and industrial wastes around Calcutta and studied the effect of discharging them into river Hooghly. Only about 25 percent of the 215 factories produced significant liquid wastes out of which paper and textile wastes contributed 97 percent. A survey of sanitary conditions along a stretch of 40 miles of the river where wastes were discharged showed that their effect was not significant.

A property of sea water which is sometimes of importance is that it is alkaline; it usually has a pH value of about 8.2 to 8.3, and contains excess base in a concentration equivalent to about 0.0026N. This may be of value when an acidic waste liquid is to be discharged into the sea, or to the more saline reaches of an estuary (Southgate, *loc. cit.*)⁴

LAND TREATMENT

The difficulties generally encountered in regard to land treatment of industrial wastes have already been referred to. However, it can be suitably adopted for wastes containing organic matter decomposable by the micro-organisms in soil. Imhoff (1937)²⁹ considered the possible utilisation of textile wastes for raising crops. A close study of the various aspects of the treatment and agricultural utilisation of the liquid wastes from the cotton textile mills at Ahmedabad was made by V. Subrahmanyam and his associates who submitted a number of reports on the subject during 1942-49 to the Municipality of Ahmedabad, to the Council of Scientific and Industrial Research and to the Indian Council of Agricultural Research, who sponsored the scheme of research. In a later publication³⁰ the suggestion was made that the mixed waste liquor be treated with gypsum powder (4 cwt. per 100,000 gals.) and be used in admixture with domestic sewage (1:2) for crop production. Sabnis (1950)³¹ studied the

clarification of kier and dye wastes using lime, calcium chloride and alum as precipitants.

Grevenmeyer (1938)³² made a survey of the practice of agricultural utilisation of trade effluents and observed that some wastes had to be diluted before application to land. Rhode (1941)³³ reported the agricultural utilisation of waste waters should be considered wherever possible.

CHEMICAL PRECIPITATION

The purposes for which industrial wastes are treated by chemical precipitants include reduction of colour, pH value and of organic matter as measured by the B. O. D. or the oxygen consumed from potassium permanganate. The usual coagulants are aluminium sulphate, ferrous sulphate, lime, ferric chloride, calcium chloride and gypsum. To obtain satisfactory results it is necessary to consider the characteristics of the waste liquor and to design the treatment plant accordingly. Where controlled amounts of chemicals are to be added to a waste water, plant operated intermittently, on the "fill-and-draw" principle, or continuous-flow plant, may be used. Here again the selection of a particular type would depend upon the nature of the waste and the extent to which it has to be purified.

Almost every type of industrial waste has been treated by this method. The method is not, however, advantageous in some cases in which bulky sludges are produced; the drying of such sludges would be difficult. In certain cases, chemical precipitation has to be followed by a suitable biological method for producing an effluent of high quality.

Mehner (1944)³⁴ studied the use of ferric chloride in the treatment of tannery wastes. Zack (1949)³⁵ suggested treatment of combined waste waters from textile factory with copperas and lime and aeration of the effluent. Seth and Bhaskaran (1952)³⁶ reported that lac waste waters containing gelatinous matter might be subjected to chemical precipitation followed by biological filtration.

BIOLOGICAL FILTRATION

With suitable conditions of operation wastes containing readily oxidisable organic matter can be purified by biological filtration. The important conditions are the rate of flow, the pore space of the filtering medium, the rate of application and the absence of toxic substances in a concentration that would affect the biological processes in the filters.

Taylor (1913)³⁷ reported that sewage containing 5 percent of trade wastes which consisted of wastes from breweries, bleach works and dye works could be treated by septic tank followed by sprinkling filters. A comprehensive study of the purification of waste waters from beet sugar factories was made by Richards and Cutler (1933)³⁸ who showed that a high degree of purification, of the order of 90 percent for press water, the most polluting of the effluents, could be obtained by the process of oxidation on percolating filters. The conditions necessary for this high degree of purification were also ascertained. Tests of Levine (1940)³⁹ indicated the very high capacities of trickling filters in removing oxygen consuming materials from crematory wastes. Kirchhoeffer (1940)⁴⁰ treated casein wastes on a trickling filter, which reduced 75 percent of its original B. O. D. Porges *et al.* (1942)⁴¹ recorded that treatment of textile wastes in combination with sewage by filtration with recirculation of effluent considerably reduced the B. O. D. Rudolfs and Trubnick (1949)⁴² found that compressed yeast wastes could be treated on circular percolation filters diluted with cooling waters containing dissolved oxygen. Irvin and French (1944)⁴³ reported that milk effluents after settlement were mixed with filter effluent and treated by two stage filtration which was more efficient than single filtration.

ACTIVATED SLUDGE PROCESS

Any waste water which could be treated by biological filtration would be amenable to activated sludge process. But activated sludge process is more sensitive and easily upset than biological filtration. It therefore requires careful control. For this reason activated sludge process is not commonly used. However, it was shown that effluents of excellent quality could be obtained by the treatment of wastes from slaughter house (Milling and Poole, 1938;⁴⁴ Mohlman, 1926⁴⁵) and milk industry (Kessner, 1934),⁴⁶ but the period of aeration required in the case of the industrial waste was more than that for sewage.

USE OF CATION AND ANION EXCHANGERS IN THE TREATMENT OF INDUSTRIAL WASTES

Since the discovery of ion exchange resins by Adams and Holmes (1935),⁴⁷ the possibilities of their application in the treatment of industrial waste liquors have been actively explored, especially in America. The process has been adopted with the object of removing some objectionable constituent from a liquor or recovering valuable material. For examples, it has been used for the recovery of copper in the cuprammonium process of

manufacturing rayon and for the recovery of tartrates from waste waters from wine-making.

A POSSIBLE LINE OF DEVELOPMENT

It may be seen from the foregoing account that the pattern of development in the treatment of industrial wastes has been similar to that in the field of sewage purification. Moreover, at many centres the tendency has been to discharge the industrial wastes along with domestic sewage. This would involve (a) pre-treatment of the industrial wastes before mixing them with sewage, (b) working out the proportions in which the mixtures should result, (c) study of the oxidative changes in industrial sewage, and (d) their utilisation, wherever possible. A fuller knowledge of the principles of sewage purification is required, but it is still lacking.

For further progress in the treatment of industrial wastes, a proper understanding of the mechanism of the simpler process of purification of sewage when it is applied to soil, when diluted with water, when treated on biological filters, and by the activated sludge process would be of great value not only from theoretical considerations but also for consistently successful practice. From this angle work has been going on at Bangalore. An observation of considerable interest that has been made is that for effective purification of domestic sewage under aerobic conditions obtaining in the different methods of treatment, including the natural process of purification during turbulent flow over a gradient land, a specific group of protozoa (Vorticellids) have been found essential. Raw sewage kept in a state of agitation, either naturally as during vigorous flow over a sloping land or artificially as in the activated sludge tank, seems to be a most favourable medium for the development and activity of these protozoa. An account of these organisms in relation to sewage purification has been given in a recent review.⁴⁸

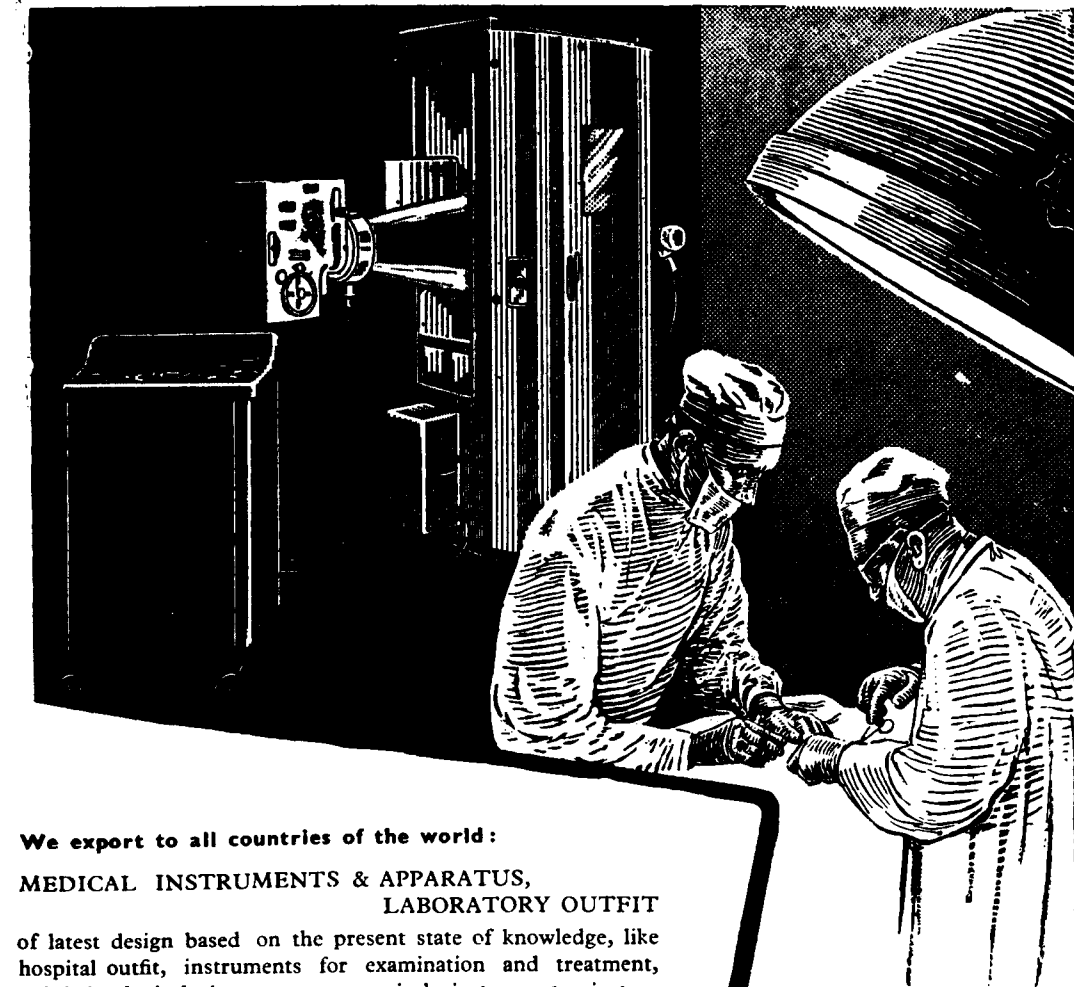
Any trade effluent that is to be introduced into domestic sewage should not materially alter the character and composition of the sewage, if the beneficial forms of protozoa should proceed to develop and purify the medium. It is for this reason that most trade effluents require pre-treatment. If the industrial waste should contain substances and chemicals toxic or otherwise detrimental to the life of the specific organisms bringing about the oxidative changes in sewage, they should be removed or reduced to concentrations that would not affect the organisms. In such pre-treatments ion exchange process and certain chemical treatments might

be found necessary. The aim of all preliminary treatments should be to alter or adjust the composition of the industrial waste liquors which might by themselves, or on admixture with sewage, be suitable media for the development of the protozoa which would then convert the waste material, any quantity of it, and as rapidly as by the activated sludge process, into innocuous or even useful products which might find application in agriculture and food production. On this and allied lines could perhaps proceed further work on the treatment and utilisation of industrial waste waters which might yield results of scientific interest and practical value in promoting environmental sanitation as also agricultural production.

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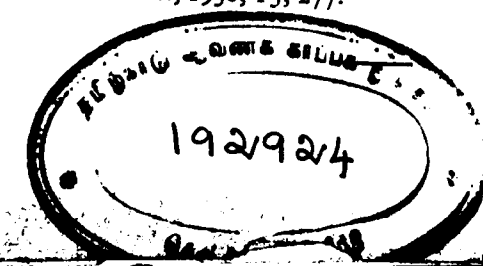
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