SPECIAL ARTICLE

THE MYSTERY AND MIRACLE THAT IS URINE

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Let me premise the article of "*Urine*" by a quatation from Fourcroy, a great Frenchman who in 1801 published his famous "*System of chemical knowledge*" its English translation in 1804 ran into 11 volumes. One entire volume was devoted to the composition of urine.

> "The urine of man is one of the animal matters that have been the most examined by chemists and of which the examination has at the same time furnished the most singular discoveries to chemistry and the most useful application to physiology, as well as the art of healing. This liquid which commonly inspires 8% men only with contempt and disgust and which is generally ranked amongst vile and repulsive matters, has become in the hands of the chemists, a source of important discoveries and is an object in the history of which we find the most singular disparity between the ideas which are generally formed of it in the world and the valuable notion which the study of it affords to the physiologist, the physician and the philosopher."

A Danish writer Isak Dinesan, puts into the mouth of an Arab, sailing along the cost of Africa, the speculation : "What is man when you think upon him, but a minutely set ingenious machine for turning with infinite artfulness, the red urine of Persia and the water of Euphrates into urine." Throughout the ancient and medieval historical periods, urine has remained a respectable and valuable commodity. Apart from its use in witchcraft and magic in primitive and medieval medicine, there is scarcely a disease that has not been treated with it either as an external application or by internal administration. In ancient Egypt, the Pharaoh suffered from a urethral discharge and sent for his physician. It would appear the physician wrote out a prescription in which the urine of a faithful wife was one of the ingredients. The myrmidons of the Pharaoh searched and searched for ten long years and at last succedeed in obtaining a specimen of urine from a faithful wife who on further examination was discovered to be a virgin.

Robert Boyle the great 17th century pioneer in chemistry is quoted as saying that the virtues of human urine as a medicine would require for their enumeration an entire volume, In the popular 18th century French "*Dictionary of Drugs*" it is stated 2 or 3 of glasses of first urine drunk in the morning and on fasting stomach is good against gout, rheumatism, hysteria and urinary obstruction. In France in the 17th and 18th centuries, the sophisticated wealthy ladies took regular urine baths to beautify the skin. It is not known whether such large collections of urine for baths, were of human or animal origin. This reminds us of the 20th century luxury of champagne and milk baths indulged in by famous film stars in

Hollywood. Such bath liquids were consumed by several admirers, lovers and fans, in glasses shaped like a miniature W. C. toilet,

Urine has had a long reputation for curing skin diseases and infected wounds in the pre-scientific centuries of medicine, Even in our present scientific era, it is a matter of interest that wayback in 1938 in a feverish search for tissue rejuvenation, one Dr. Ernest Futurman of the Kaiser-Wilhelm Institute, turned to urine and succeeded in extracting a new product, which he named '*Trelictine*' which was found to be a remarkable biological stimulant. Extensively tried in sports and mountain climbing expeditions, it proved its worth. Doctor Else K. La Roe a famous woman plastic surgeon, in her autobiography mentions an incident that revealed the potency of the new drug. Just before World War II, a German-Swiss Himalayan expedition was supplied with Trebiotine tablets for use in their arduous mountain climbing. The English correspondent at Delhi furnished daily reports of the miraculous success of the Trebiotine tablets in keeping the climbers alert and unfatigued. But at the end of the first week, an urgent message arrived in Berne Switzerland. The message was in German which on translation '*Send something against stand*" and it made no sense to the recipients of the cable. The puzzle was solved when the expedition was cut short due to the imminence of war and the mountaineers returned home. The medication, they reported was so powerful that after 14 hours of climbing at an altitude of 18,000 ft. their sleep was disturbed by steady unrelieved priapism. Although the organic compound Trebiotine proved its value as a remarkable biological stimulant and rejuvenator, it was found, the chemical chains that made up the drug, were highly unstable and unreliable after three months. It would appear, the problem of stabilizing it has not been solved. The miracle of the drug is attributed to certain enzymes, auxins and hetero-auxins found in urine and in cow manure.

Of still more historical interest than these unproved and unconfirmed medicinal virtues, is the use of urine in diagnosis and prognosis. It is recorded that Sumerian and Babylonian physicians described the colour, consistency and frothiness, the presence of clouds and sediments, casts and blood in urine, when they attempted to correlate with various diseases. In Hindu medicine, preserved in the writings of Charaka and Susrutha, the urine was systematically classified into 20 varieties, corresponding to so many kinds of morbid conditions. The Hindus were the first to identify, the disease Diabetes mellitus which they named of "honey urine" in the diabetic, using ants as a diagnostic tool, because the urine of a diabetic quickly invited these insects in swarms. In this connection, I may tell you a story about Col. Donovan of Kala-azar fame. Way back in 1914, Donovan when Professor of Physiology in the Madras Medical College played a practical joke on the sophomores of that year in the practical, chemical physiology class. Specimens of diabetic urine were kept on the work tables of the students for testing and estimating their glucose content. The professor told the students who were ranged along their respective work desks, each holding a specimen of urine,

that they should taste the specimen by dipping the tip of their index finger and to set en example himself tasted the specimen with his index finger. The unsuspecting students, quickly followed suit and confirmed the sweet taste of the specimens. Subsequently we detected the joke. The professor no doubt dipped the tip of his index finger into the specimen but the finger that was put into his mouth was the undipped middle finger! In the Hippocratic texts the characteristics of urine in disease are mentioned 182 times and used both for diagnosis and prognosis.

Coming to the centuries after Christ, it is found that Theophilus in the 7th century mentioned the application of heat as a diagnostic test, referring to the cloudiness caused by albumin containing urine. Avicenna in the 11th century A. D. pointed out the difference between the urine passed in the morning and that passed at night and observed the influence of age, food and drugs on its colour. From the 12th century onwards for several succeeding centuries, the art of 'uroscopy' arising possibly in Persia, spread throughout the Middle East, Europe and North Africa. Uroscopy was the art of making a diagnosis and prescribing therapy solely on the evidence afforded by the visual examination of the urine. Towards the close of the 12th century a Salernan physician, Gillies De Corbeil wrote a long poem on uroscopy entitled '*Liber De Urinis*' which served to popularize the practice to such an extent that it excluded all other forms of medical observation. It became pure quackery. The water doctor, also known as the urine caster, the urinarian and the 'piss prophet' largely ignorant of both anatomy and therapeutics with his elaborate gown and head-dress, his mysterious urine flask and his solemn mien, must have had a strong appeal for the sick and possibly imparted to them some measure of psychosomatic benefit. They travelled the country on horse-back with only a urine glass slung in the arm and were preying on the credulity and the ignorance of the people. The urine caster became the subject of almost every illustrious artist of the day and one painter even portrayed Jesus Christ in this role! It is related that the water doctor would be at pains to gather advance information about his patients. In the waiting room when the patients sat nursing their urine vials would be a creature of the doctor in the guise of a patient. It was this individual's function to start up a conversation in which the patients would babble away about their symptoms, or about the symptoms of those whose specimens they had brought. Behind a thin wall containing a spy hole, would lurk the doctor, busily taking notes and description. When satisfied that he had gathered sufficient information, he would put on his professional clothes, leave the house by a back door, and come bustling in at the front door as if he has just returned from his rounds. The patient would be called one by one, and the doctor in his gravest manner, transferring the urine specimen into his specially shaped flask, would glance at it, and asking no questions would tell them what they already knew, namely their husbands had back pains or their mistresses were pregnant. Such would be the visitor's astonishment and respect that the doctor would have no difficulty in selling his expensive drugs. These quacks were taking away the bread out of the mouths of the orthodox physicians of those days.

It is related of one Dr. Radcliffe, Physician to Queen Anne and remembered by the famous library at Oxford that when visited by a shoe-maker's wife with a vial of her husband's urine he is said to have refilled it with some of his own urine and said " Go and tell your husband to make me a pair of shoes by this water; for he will know by it how to fit my foot, as well as I can by his water know what disease he has ". Shakespeare's Falstaff entertained the same simple faith as the shoemaker's wife. Falstaff sent his urine through his boy to the water-doctor When the boy returned, Falstaff queried, " Boy, what said the doctor to my water ". The boy replied, " Sir, the water itself was a good healthy water, but as for the party that owned it, he might have more diseases than he knew for ". Apart from the very questionable role which the urine has played in the diagnosis and therapy of diseases since historical times, the urine of men and animal played a notable part in the practical arts, in alchemy and served as a foundation for the science of chemistry.

Urine is a weak, detergent by virtue of its urea-content and this property is greatly enhanced when it is allowed to undergo bacterial fermentation. Such fermented urine has been used since time immemorial as a soap. In Roman times urine became the agent of choice in cleansing, softening, bleaching and dyeing of wool and cloth. In Rome, the fuller's vats and other public reservoirs of human and animal urine, because of the nauseating noxious smell were, banished outside city limits, So important was urine in Roman industry that the Emperor levied a tax on such as was collected in the public reservoirs. There is a tradition in Scotland that the highland Homespun or Harris tweed is expected to carry the odour of the fermentation vat. It is common knowledge that urine all over the world has been used as a fertilizer. Fermented urine has been used in the tanning and softening of hides and for extracting dyes from various plants. It would appear that in relatively recent times it has been used to macerate tobacco leaves in the cigar industry and to flavour cheese!

The alchemist has long used urine in their search for the philosopher's stone. They prepared the volatile salt '*Sal ammoniac*' for medicinal use by the dry distillation of fermented urine and it played an important role in alchemical operations. The pungent volatile gas, free amonia, liberated by the action of alkalies on Sal ammoniac was demonstrated by Sheel and Berthollet to be composed of nitrogen and hydrogen in the quarter of the 18th century.

It was from decomposing urine that the element phosphorus was discovered isolated for the first time by the alchemist Brandt of Hamburg in 1669. It would appear that Brandt sold the secret of its preparation to a man named Krafft who in 1667 exhibited some elementary phosphorus in England where it attracted the curiosity of English chemists. In 1678 Kunekel and in 1680 Boyle worked out Brandt's secret evaporating urine and dry distilling the residue collecting the distillate under water. As has often happened in the history of new discoveries

the discovery was by one man but the beneficiary was another. A druggist of London, one Mr. Hawbritz to whom Boyle communicated the method, prepared phosporus from urine for more than 20 years and amassed a fortune by selling it to all the philosophers of Europe for a fancy price. Urine remained the sole source of this exciting element until Scheele in 1775 developed a method of preparing it from bones. Even after this new source, urine continued to be a more economical source of phoshorus.

In the 17th and 18th centuries, chemistry began to develop as a quantitative science and urine was to supply much of the basic knowledge of the composition and transmutation of the substances in living animals. In 1655, Van Helmont determined the specific gravity of urine and the physiologist Haller quantitatively related the changes in concentration to the intake of water or fluid meals. Before the end of the 18th century, chemists had prepared several inorganic salts; the chlorides of sodium, potassium, ammonia and the several phosphates of ammonium, sodium, magnesium and calcium etc. The acidity of normal human urine was discovered when it turned syrup of violets red. This led to the study of the variations in the acidity of the urine laying the foundation for the modern study of acid–base balance.

The sweet taste of urine in Diabetes Mellitus was rediscovered by Thomas Willis in 1664. It was only in 1838, that Bon–Chardat and Palligot identified the urine sugar as glucose. The classic studies of Claud Bernard on glycosuria and liver glycogen revealed that glucose was the major fuel of the body. The subsequent work of Minkowski on glycosuria on depancreatized dogs initiated the modern era of carbohydrate metabolism.

The most important was the discovery of *urea*. Von Rouelle was the first to separate this compound from urine in an impure form in 1773. Fourcroy with his colleague developed a quantitative method for its determination by precipitation as the nitrate salt and showed that it is a constituent of the urine of all animals. The discovery of urea epitomized the great division between the organic and inorgenic world. When Wohler in 1828 synthesized urea from a simple solution of inorganic ammonium cyanate, the distinction between the organic and inorganic kingdom was lost. As urinary glucose was to supply the key to carbohydrate metabolism, so was urea to supply the key to the metabolism of protein and derivatively to the metabolism of fat. The recently accumulated knowledge about urea is of great importance to the urologist and the dermatologist:—(1) Urea has been found to have bacteriostatic and bactercidal properties particularly on the Pseudomonas and proteus group of organisms; (2) It has the ability to dissolve necrotic tissue; (3) it can overcome the sulphonamide inactivating properties of (PAB) para–amino benzoic acid; (4) it can increase the solubility of sulpha drugs and thus produce a potentiation of their activities; 4% of urea in 5% glucose in water given intravenously induces osmotic diuresis, maintains homeostasis in regard

to electrolytes and water, regardless of whether anti-diuresis is present or not and (5) a 30% solution of urea is an effective keratolytic agent in dermatology.

Thanks to the spectacular developments in physiology and biochemistry during the past 100 years, an enormous number of organic components have been isolated from normal urine. Many of these are metabolities and degradation products of internal secretions. Chemical and biological methods of assaying these metabolitics are increasingly used in the diagnosis and prognosis of endocrine disorders. Biochemical bacteriological and cultural examination is an obligatory routine procedure in all genito-urinary disorders both for diagnosis and treatment control. Urine has been the key for the discovery and recognition of a variety of rare inborn disorders of metabolism such as alkaptonuria, porphyrinuria etc. In the diagnosis of adreno-cortical insufficiency and Diabetes Insipidus simple water-loading and saline-loading tests and measuring the excretory rate in the urine, have helped the clinician. A recent test has been evolved for the diagnosis of latent diabetes by estimating the glucose in an eight-hour collection of urine after three successive doses of prednisone administered to the patient every 4 hours. In a lighter vein, it may be mentioned that the urine of dogs and cats is stated to contain a substance that can attract a romantically inclined female at a distance of 150 yards. Urine has afforded the clue to some of the newly discovered disorders such as carcinoid of the intestinal tract and hyperaldesteronism and phaeochromocytoma. The urinary chorionic gonotrophin of pregnancy has recently achieved a new therapeutic distinction apart from its recognized use, as a diagnostic test in pregnancy. In the starvation treatment of obesity where the patient is restricted to only 500 calories of food, the daily injection of the chorionic gonctrophins keeps the patient alert, active and unfatigued and seems to act as an appetite-suppresant indirectly. When the old Pharaoh was prescribed the urine of a faithful wife, the physician must have emphasized the importance of the pregnant state rather than the faithfuln ss of the wife.

While on the subject of urine, the 'Lancet' in a recent editorial has deplored that "routine urine-testing has become one of the casualties of progress towards more and better diagnosis". This once highly respected bedside-procedure has fallen on evil days. In the collection of the urine and its migration from the bedside to the side-room or the clinical laboratory, it has suffered a succession of vicissitudes and the reports by noughts and crosses are anything but helpful to the physician. It is not unusual to see urine specimens in conical glasses standing for hours on end in the ward side-room, or even in the clinical common laboratory before they are examined. In the meanwhile our ubiquitous urea-splitting friends have a field day on the specimens converting them into malodorous fermenting juice and rendering them unfit for examination. The ascending echelon of the student, the internee, the house-officer, the Asst. Physician and the Chief rarely has the time or inclination to check up the least glamorous part of his demain. The examinations are carried out either by the ward orderley or a probationary

nurse with often the student or the internee looking on or trying to whisper a salacious joke at the expense of the nurse whose back or profile becomes the subject of the comment.

Two members of the Pathology staff of St. Andrews University, Aberdeen, took time to investigate the customs and standards of routine urine-testing in the side-rooms of the wards. Kirkland and Morgan of St. Andrews University as quoted in the Lancet, in a comparative study of the results of urine examination in the ward side-room and those of the pathology laboratory on the same specimens, reported that among 1033 urine samples referred for protein in the laboratory, 231 were positive for protein while the ward side-room missed 117 (42%) and 21 ward positives proved negative in the laboratory. Sugars and reducing substances fared no better. In 1033 specimens, the wards had missed 108 positives to both Benedict's reagent and the labour-saving clinistix and test-tape methods. It is time we think of introducing labour-saving devices such as strips, sticks, tapes and tablets for the routine examination of protein and sugar both in private practice and in medical institutions where a very large number of specimens of urine have to be routinely tested. There are the various '*tixes*', '*albusti*', '*clinistix*', '*uristix*' then the '*test tape*' and the Clinitest set and Ace test and the universal PH indicator. The only snag about these devices is that they deteriorate with time and lose their sensitivity in 6 months. The editorial ironically and rightly stated that " routine urine testing in the wards emerges as a marginally more exact science than palmistry but not one which could fairly be compared to an intelligent game of noughts and crosses. "

To conclude on a philosophical strain, it may be said in a great measure that man is what he is, because his urine is what it is.

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